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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....157, 163
The 721-ft. Three-Hinged Steel Arch Railway Bridge across the River Viaur, France (with two-page plate and other illustrations)..... 158
Regulation in Long-Distance Power Transmission by Electricity..... 161
A Traveling Concrete Mixer (illustrated)..... 162
Creeping of Rails on the St. Louis Bridge..... 163
The Construction of Moisture-Proof Underground Chambers (illustrated)..... 166
A Submarine Arc Lamp (illustrated)..... 167
Paris Exposition Awards to American Exhibitors in the Mechanical Engineering and Mining Engineering Departments..... 168
Graphite Paint as a Scale Preventative for the Heating Surfaces of Steam Boilers..... 168
Book Reviews..... 169
A Balanced Shaking Screen (illustrated)..... 169
The Canadian Meeting of the American Institute of Mining Engineers..... 169
A Signaling Device for Mines (illustrated)..... 170
Annual Convention of the American Society of Municipal Improvements..... 171
EDITORIAL NOTES..... 164
The Hatfield Collision on the Philadelphia & Reading R. R.—Recent English Experience with the Septic Tank.—The Maintenance of Street Pavements.—"Shooting Cannon at Clouds in France."—Engineers and the American Economic Association.
EDITORIAL:
The Future of the American Society of Municipal Improvements..... 164
LETTERS TO THE EDITOR..... 165
An Invitation to Engineers to Become Members of the American Economic Association.—Flow of Water Through Clean and Through Dirty Pipes.—Comparative Cost of Filtration at Albany and Lawrence.

THE TRANSATLANTIC RECORD has again been broken by the new "Deutschland" of the Hamburg-American Line, which made the distance of 3,050 knots from the Mole off Cherbourg to Sandy Hook in 5 days 12 hours and 29 minutes on her last western trip. The record of daily runs for the trip were: 337, 566, 570, 570, 584 and 423 knots. By making 584 knots on the next to the last day the vessel broke the best previous record of the distance run in 24 hours, which was held by the "Kaiser Wilhelm der Grosse" of the North German Lloyd Line, by four knots. The steamship "St. Paul" of the American Line also beat all her previous records of time from Cherbourg to New York on her last trip. The distance of 3,052 knots was covered in 6 days 7 hours and 52 minutes, and the longest 24 hours' run was 514 knots.

SHIPBUILDING IN THE UNITED STATES for the year ending June 30, 1900, is reported upon by the Treasury Bureau of Statistics. The number and tonnage of the various classes of vessels are given as follows:

Class.	No.	Gross tons.
Schooners, schooner barges and sloops....	499	109,605
Great Lake steam vessels.....	25	97,847
Canal boats and barges.....	523	74,860
Ocean screw steamships	20	60,369
River steamers	375	44,282
Square rigged vessels	4	6,205
Total	1,446	393,168

The steam vessels built—420, of 202,498 gross tons—surpass the record, the nearest approach being 1891, when 488 steam vessels of 185,037 gross tons, were built. The steel vessels built—90, of 196,851 gross tons—exceed the previous record year, 1899, when 91 such vessels, of 131,379 gross tons, were built. Cleveland, Ohio, ranks first as builder of steel vessels, with 9 steamships, of 42,119 gross tons, followed by Newport News, 7 steamships, of 28,202 gross tons; Chicago, 5 vessels, 24,504 tons; Detroit, 4 steamships, 15,093 tons. The total tonnage built and documented on the great lakes during the year—125 vessels, of 130,611 gross tons—is the largest in the history of that region. The total for the Middle Atlantic and Gulf Coasts—605 vessels, of 135,478 tons—exceeds any record since 1872. The total for the New England Coast—199 vessels, of 72,179 gross tons—has not been equaled since 1891, while the product of the Pacific Coast—300 vessels, of 40,396 tons—is surpassed only by the returns of 1898 and 1899. Construction on the Mississippi River and tributaries—217 vessels, 14,509 tons—is 9,000 less than 1899. The foregoing figures do not cover yachts or Government vessels.

CONTRACTS FOR TEN STEEL VESSELS have recently been placed with the American Shipbuilding Co., of Cleveland, O. One order by D. R. Hanna is for two steamers and two consorts, to carry 4,000 tons each. The steamers will be 314 ft. keel, 42 ft. beam and 26 ft. deep. They will be driven by triple expansion engines, supplied with steam from Scotch boilers. The schooners will be 300 ft. long. J. G. Gilchrist has ordered in all this year six 5,000-ton steamers. They are 366 ft. over all, 346 ft. keel, 48 ft. beam and 28 ft. depth of hold. The American Shupbuilding Co. now has 17 vessels under contract.

A LARGE DIPPER DREDGE for work on the Massena Canal has been launched at Ogdensburg, N. Y. The dimensions of the hull are 115 ft. long, 40 ft. beam, 12.2 ft. draft at the bow and 10½ ft. draft at the stern. The A-frame is 38 ft. high and the boom is 48 ft. long, giving the dipper a working radius of 52 ft. The possible depth of excavation is 30 ft. below the water surface. The dipper has a capacity of 8 cu. yds.

A FAST CANAL BOAT SERVICE is proposed for the Illinois & Michigan Canal and the Illinois River, between Chicago and La Salle. In view of the numerous important towns along the route, the Wallace Transportation Co. has been organized to put on a service of screw steamers for package freight, the boats to be of steel, about 110 ft. long, with a draft of 4 ft. 8 ins. If the venture is successful the service may be extended.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a rear collision on the Philadelphia & Reading Ry., at Hatfield, Pa., Sept. 2. An excursion train from Allentown and Bethlehem, Pa., bound for Atlantic City, N. J., ran into a milk train standing at the station at Hatfield. The locomotive plowed through two passenger coaches on the rear of the milk train, killing four persons therein. Two coaches of the excursion train were also completely wrecked, and many people in them were killed or injured. The total casualties are 15 killed and more than 50 injured. There are conflicting reports regarding the responsibility for the accident. There is no block-signal system on this part of the line, but a rule prohibiting trains following closer than five minutes is in force. A fog prevailed at the time of the accident. The following statement has been made to a press reporter by Mr. I. A. Sweigard, Superintendent of the Philadelphia & Reading Ry.:

The milk train left Bethlehem at 5.20 a. m. and the excursion train 45 minutes later. The engineers of both trains had duplex orders, informing each that the milk train was to be sidetracked at Lansdale to allow the excursion train to pass. At Perkassie the trains were 21 minutes apart. At Sellersville they should have been 17 minutes apart, but were instead only 11 minutes apart. Here Groves (the train dispatcher at Philadelphia) tried to get the orders through to hold the excursion train. At Telford, 4¾ miles from the scene of the wreck, there were six minutes between the trains, and at Souderton only three minutes. The station agent at the latter place should have shown a stop signal, as is required when trains are five minutes or less apart. An investigation only will show whether he did not or whether the engineer failed to obey it.

THE ROGERS LOCOMOTIVE WORKS, which was reported last week as about to be closed, may yet be continued through the efforts of citizens of Paterson. It is stated that from $300,000 to $500,000 will be necessary to make necessary improvements and provide working capital; and an effort is to be made to raise this amount by local subscriptions. The works employ about 1,500 men and can turn out about 20 locomotives per month. The works were founded by Thos. Rogers, and the first locomotive was the "Sandusky," a ten-ton machine, built in 1837, for the Mad River & Lake Erie R. R. Mr. Rogers died in 1856. His son, Jacob S. Rogers, is still the principal owner of the works, but desires to retire from active business being now 77 years of age.

EXCHANGING OLD RAILS FOR NEW at a profit was accomplished last year by the Chicago Great Western Ry. Co. According to its annual report, just issued, the company in 1899 purchased 10,000 tons of 75-lb. steel rails at $19 per ton. While they were being laid in the track and the old ones taken up, the iron market advanced to such an extent that the old rails were sold for about $10 per ton more than the new ones cost. It is of interest also to notice that, according to this report, rails are now removed through stress of competition much sooner than economy would dictate. We quote as follows:

This rapid renewal of rails is forced upon the company by competition, rather than by due regard to economy. The rails which have been taken up were so nearly perfect that they have been eagerly purchased by non-competitive lines for relaying rails, and a due regard for economy would have required that they remain in the track for several years longer.

THE TREND OF PRICES in the building trades is shown by the following estimates for a ten-story fire-proof loft building on a 50 × 100 ft. corner plot, taken from the New York "Sun":

	January		August,
	1898.	1899.	1900.
Mason contract.....	$78,125	$96,875	$87,500
Iron contract	43,750	62,500	50,000
Carpenter contract	15,625	22,500	22,500
Steam heating contract.....	6,250	8,750	8,125
Plumbing contract	3,125	4,375	3,750
Electric wiring contract.....	1,875	2,500	2,500
Elevator contract	5,625	6,250	6,250
Caisson contract	7,500	9,375	9,375
Totals	$161,875	$213,125	$190,000

The present cost of fire-proof loft construction is about 27 cts. per cu. ft., in January it was 30 cts. and a year and a half ago it was 22 cts.

THE CAPE BRETON COAL PROPERTIES, controlled by the General Mining Association of London, England, have been transferred to the Nova Scotia Steel Co., a corporation which is planning a large steel plant, with iron and steel works at North Sydney and shipbuilding yards at Halifax. The sale includes the mines and mining plant of the General Mining Association at North Sydney, and about 100 other coal properties involving an area of 21 miles. The purchase price was $1,500,000.

COAL CONSUMPTION IN BLAST FURNACES varies with the amount of moisture present in the air. In a recent discussion before the Pittsburg Foundrymen's Association it was stated that under normal conditions with the temperature at 70° F., 1,000 cu. ft. of air, equal to 75 lbs., contains 1 lb. of moisture and that each pound of moisture requires one additional pound of coke. Tests have proved that when the air is charged with moisture, from 200 to 300 lbs. more coke are required for producing a ton of iron than when the air is dry and comparatively little moisture is blown into the furnace. Heating the air does not eliminate the moisture and up to the present time no means have been devised to take the surplus moisture out of the air. Tests made in the South show that more coke is required there to reduce one ton of iron than at furnaces in the North. Furnaces in the Pittsburg district and in the valleys require on an average of from 100 to 200 lbs. coke more during damp or wet weather to reduce the charge than under very favorable conditions. In cupola practice these variations due to atmospheric conditions are also encountered. Experiments are now being made by chemists to reduce the amount of moisture in the air before entering the stoves for blast furnaces.

IRON AND MANGANESE SAND DEPOSITS may yet become the foundation of a large industry, according to the "Indian Agriculturist." The material is said to be very pure and to exist in great quantities in eastern and central India. On the western branch of the Terriahghat River there are said to be layers of manganese two to three feet thick. Communication between these deposits and the coast, though not exactly all that can be desired, is being rapidly improved, and as coal for smelting, fireclay for furnaces, limestone for fluxing, and (if required) petroleum for annealing, are all abundant in the vicinity, a very important and highly remunerative industry could be established at the foot of the hills in the North Sylhet district. The almost incessant earth tremors would be an obstacle to the construction of extensive works, but throughout the cold weather tons of manganese could be sluiced at very small cost, and when the rains opened the waterways, it could be sent to the coast without breakage of bulk, or, if advisable, transferred to the railway at Chandpore on the Megna, for export via Chittagong.

AN UNDERGROUND ELECTRIC RAILWAY SYSTEM in the business district of Chicago has been proposed by Mr. J. M. Roach, Pres. of the Chicago Union Traction Co., and he has presented plans to the Street Railway Commission. The design shows a four-track tunnel 32 ft. below the street level and with a height of 14 ft. The cost is estimated at $2,000,000 per mile.

FERRO-TITANIUM is to be manufactured in large quantities at Niagara Falls, according to a recent report. The Ferro-Titanium Co. has had an experimental plant in a building on the lands of the Niagara Falls Power Co. for some time, but now it has been decided to build a plant with a capacity of five tons per day.

THE STARTING OF THREE-PHASE INDUCTION motors is the object of a recent invention of Herr V. Fischer-Hinnen, of Prague, Austria. In series with the secondary winding is connected a large non-inductive resistance, which is shunted by a coil having low ohmic resistance, but high self-induction. All that is required to start the motor is to close the switch connecting the primary winding with the mains. The induced currents in the secondary are at the beginning of high frequency, and neither the impedance coil nor the ohmic resistance will allow a very large current to pass. But, as the motor speeds up, the frequency becomes lower and lower and the apparent resistance offered by the impedance coil falls correspondingly, until at full speed it is very small. The presence of the coil has only a slight influence on the normal running of the motor, there being a slight diminution of the power factor and a slight increase in the amount of slip.

A MACHINE FOR HULLING RICE has been invented by Mr. C. H. A. Ligford, of Cincinnati, O. The working part of the machine is a carborundum wheel or cylinder, 16 ins. in diameter and 36 ins. long. There are 33 corrugations on the surface and these are deep and sharp enough to cut the hull without injuring the kernel. The rice will be fed upon the roll from a hopper above and a stiff brush will hold the grain to the wheel while the hull is being taken off. After this a fan will separate the husks from the grain.

THE 721-FT. THREE-HINGED STEEL ARCH RAILWAY BRIDGE ACROSS THE RIVER VIAUR, FRANCE.

(With two-page plate.)

General.

One of the most notable metal arch bridges of recent years is the so-called Viaur viaduct, built to carry the railway line of Carmaux-Rodez across the valley of the River Viaur in France. In our issue of July 6, 1899, we described briefly

FIG. 20.—MODEL OF THE VIAUR VIADUCT IN THE FRENCH CIVIL ENGINEERING EXHIBIT AT THE PARIS EXPOSITION.

the general character of this structure, and gave some of its principal dimensions, and in this issue we publish the more interesting details of the steelwork and foundations. To make these details clearly understood, however, we reproduce the diagram elevation and part plan, and repeat some of the general dimensions given in the previous article. Fig. 1 is the diagram elevation and plan. As will be seen from these drawings, the structure consists of three metal spans flanked by masonry arch approaches. Its total length is 460 m. (1,508.8 ft.), and its length between approaches is 410 m. (1,344.8 ft.). The masonry approach arches, two on one side and three on the other, are each of 7 m. (22.96 ft.) span. The metal portion of the viaduct consists of two shore spans of 95 m. (311.6 ft.) each, composed of a cantilever arm 69 m. (226.32 ft.) and a suspended truss 26 m. (85.28 ft.); and of a three-hinged arch main span 220 m. (721.6 ft.) c. to c. of end pins, and 116 m. (380.48 ft.) high from the bottom of the valley to the base of the rail. The rise of this arch is 53,731 m. (176.24 ft.).

The principal members of the superstructure are the two braced arch ribs hinged at the crown and abutments of the center span and continusing as cantilevers over the abutments to form, with the suspended trusses, the shore spans. These two arched ribs are spaced 33.89 m. (100.5 ft.) apart c. to c. at the abutments, but incline toward each other so that their distance apart at the top chord is only 5.89 m. (19.3 ft.) c. to c. of chords. Each rib consists of a horizontal top chord and a polygonal bottom chord connected by web bracing of upright and diagonal members. At the top the two arch ribs are connected by the framing of the floor system, and between the opposite upright web members there is a bracing of horizontal struts connected by X-bracing. In the plane of the bottom chord there is also a system of horizontal struts and X-braces. All the main bracing is composed of stiff members, and all connections are riveted.

The material employed for the superstructure was wrought and cast steel, except for the suspended trusses of the shore spans, the rivets, the flooring, the foot-walks and ladders provided for the inspection and repair of the metalwork, and certain of the castings, which are of wrought and cast iron. Altogether the work contained 2,841,310 kg. (6,250,882 lbs.) of wrought steel, 491,375 kg. (1,081,025 lbs.) of wrought iron, and 98,600 kg. (216,920 lbs.) of forged and cast steel, cast iron and lead. The total weight of the metalwork, according to these figures, was 7,548,827 lbs., or about 3,775 tons.

Before taking up the details of the various parts of the structure, it will be interesting to compare its principal structural features with those of other large steel arches. In the accompanying table, abstracted from a tabular statement recently published in "Zeitschrift des Oesterreischischen Ingenieur und Architekten Vereins," we give the location, structural material, and main dimensions of 24 of the largest steel arch spans in the world.

It will be observed from this table that the Viaur Viaduct stands second in length of span among the steel arch bridges of the world. As originally designed, moreover, this arch was intended to have a span of 250 m. A description and illustrations of this original design was published in Engineering News of Nov. 30, 1880. It was submitted by the Societe des Batignolles. This same firm also carried out the modifications in the original design, which resulted in the plans from which the bridge was actually built as illustrated herewith. These modifications consisted essentially in increasing the depth of the arch ribs at the skewbacks, and thus shortening the span. By this change a reduction was made in the contract price from 3,000,000 francs to about 2,452,000 francs.

Substructure.

The substructure proper of the Viaur Viaduct consists, strictly speaking, of the four skewback piers, on which the arch ribs rest. The masonry approach arches, however, are designed to serve as abutments as well as approaches for the metal spans, and are, therefore, quite properly included under this heading. These abutment approaches are, respectively, 21 m. (68.8 ft.) and 29.2 m. (95.77 ft.) long, and consists, respectively, of two 7-m. (22.96 ft.) and three 7-m. stone arch spans. The arch masonry consists of Bruniquel limestone ashlar facing and a rubble backing of gneiss excavated from the foundations. The pier facing and arch ring stone are rough-faced, but the spandrel wall stone are hammer-dressed. This construction and the arrangement of the bridge seats are shown fully by Fig. 2.

The construction of the skewback piers is shown in detail by Fig. 3. There are four of these piers, a pair at each end of the center span. The two piers of each pair are spaced 33.4 m. (109.5 ft.) apart c. to c. on opposite sides of the longitudinal axis of the bridge. Each pier consists of a mass of masonry, with an interior anchor girder chamber, having a tunnel entrance. The lining of these interior compartments and the facing of the exposed surfaces of the piers are of rock-faced ashlar of Bruniquel limestone. The three capstones are of granite cut carefully to dimensions, and the backing is of rubble masonry, for which the gneiss of the foundation excavations was used. The dimensions of the different parts of each pier are shown fully by the drawings of Fig. 3. These same drawings also show the general character of the anchors.

The anchor rods, which connect with the feet of the arch ribs in a manner which will be described further on, pass down through the pier masonry into the anchor girder chamber and are fastened by a nut to a cast washer bearing having a base 1 × 0.42 m. (3.28 × 1.37 ft.). To take the pull of this anchor rod the cast washer is given a bearing against four plate girders 0.5 m. (1.64 ft.) deep, and 3.5 m. (11.48 ft.) long, which extend transversely across the chamber and have their ends embedded 0.75 m. (2.46 ft.) in the wall masonry. These plate girders in turn pull against six longitudinal plate girders 0.5 m. (1.64 ft.) deep and 4 m. (13.12 ft.) long, which are so bedded in

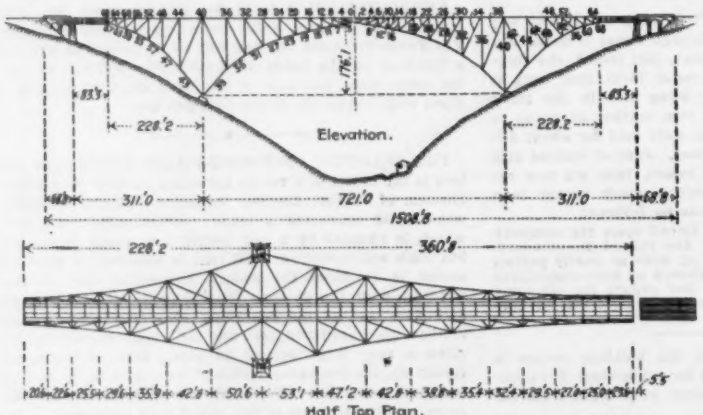

FIG. 1.—DIAGRAM, ELEVATION AND PART PLAN OF VIAUR VIADUCT.

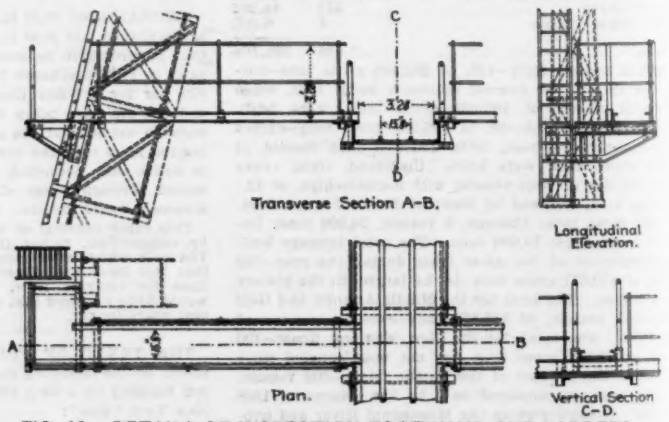

FIG. 19.—DETAILS OF INSPECTION FOOTWAYS AND LADDERS.

Table of Location, Structural Material and Main Dimensions of 24 of the Largest Steel Arch Spans.

Location.	Character.	Material.	Meters— Span.	Rise.	Span ÷ rise.
Niagara River	Road.	Steel.	256.1	45.73	5.6
Viaduct	Railway.	"	220.0	53.731	2.4
Bonn Bridge	Road.	"	187.92	29.6	6.3
Duesseldorf Bridge	"	"	181.25	27.7	6.5
Ludwig I. Bridge	"	Wrought iron.	172.0	44.5	3.9
Muengsten Bridge	Railway.	Steel.	170.0	66.8	2.5
Niagara River	"	Steel.	167.7	34.75	4.8
Garabit Viaduct	"	Wrought iron.	165.0	56.9	2.9
Lavaur Viaduct	"	" "	163.4	21.1	7.7
Plauenia Bridge	"	" "	160.0	42.5	3.7
Eads Bridge	Ry & rd.	Steel.	158.6	14.3	11.1
Grunenthaler Bridge	"	Wrought iron.	156.5	23.5	7.3
Washington Bridge	Road.	Steel.	155.1	27.4	5.6
Adda Viaduct	Ry & rd.	?	150.0	37.5	4.0
Genesee River Bridge	Road.	Wrought iron.	129.0	20.4	6.3
Richmond, Md., Bridge	"	" "	122.0	12.2	10.0
Kornhaus Bridge	"	Steel.	114.9	31.5	3.6
Schwarzwasser Bridge	"	Wrought iron.	114.0	21.48	5.3
Theiss Bridge	"	?	110.0	?	?
Hondo, S. A., Bridge	Ry & rd.	Wrought iron.	109.7	15.85	7.0
Rhine River, Coblenz	Railway.	" "	106.0	8.6	12.3
Rhine River, Worms.	Road.	Steel.	105.6	11.09	9.5
Stoney Creek Bridge	Railway.	"	102.4	24.5	4.2
Rhine River, Mainz and Cartel	Road.	Wrought iron.	102.0	10.0	10.2

Note.—More complete descriptions of a number of these structures will be found in Engineering News as follows: Bonn Bridge, 1895, Vol. II., pp. 85 1899, Vol. I., pp. 242, 248, 268, 286, 302; Duesseldorf, 1899, Vol. I., pp. 242, 248; Muengsten, 1898, Vol. II., pp. 136, 139; Niagara River highway and railway, 1896, Vol. I., pp. 13, 105; 1896, Vol. II., p. 82; 1897, Vol. I., p. 252; 1898, Vol. I., pp. 103, 330, 336, 370; Vol. II., pp. 72; 1899, Vol. II., p. 357; Stoney Creek, 1894, Vol. II., p. 84; Kornhaus, 1895, Vol. II., p. 402; 1897, Vol. II., p. 386; Theiss River, 1898, Vol. I., p. 340; Garabit, 1884, Vol. II., pp. 65, 98.

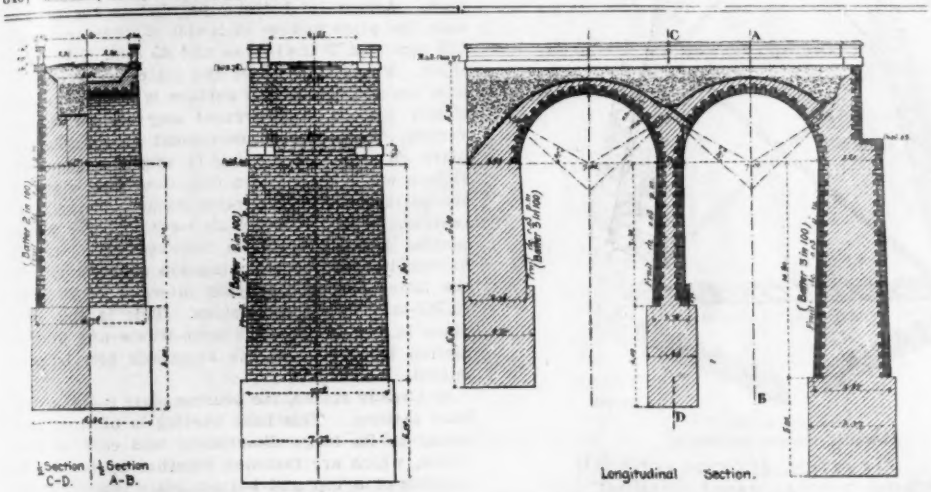

FIG. 2.—ELEVATION AND SECTIONS OF ABUTMENT APPROACH ARCHES.

the masonry above the chamber that their bottom flanges are just flush with the ceiling masonry of the chamber.

Besides the permanent anchor just described, there is built into each pier another anchor fastening the base casting of the skewback hinge to the skewback masonry. The construction of these anchors is similar to that of the regular bridge anchors, except that they are entirely embedded in the masonry.

The maximum pressures on the pier masonry are as follows: Arch rib on capstone, 512 lbs. per sq. in.; lower capstone on rubble masonry, 171 lbs. per sq. in.; masonry on foundation bed, 99.6 lbs. per sq. in.

Superstructure.

The general character of the superstructure framework is shown by the diagram elevation and plan, Fig. 1. It is shown more clearly by the drawings of Fig. 4, which comprise a side elevation, a transverse section and a plan of the framing composing the panel between web posts 28 and 32. This panel is typical of all the others, except for certain details, which will be described separately, and a description of its framing will answer for the entire bridge.

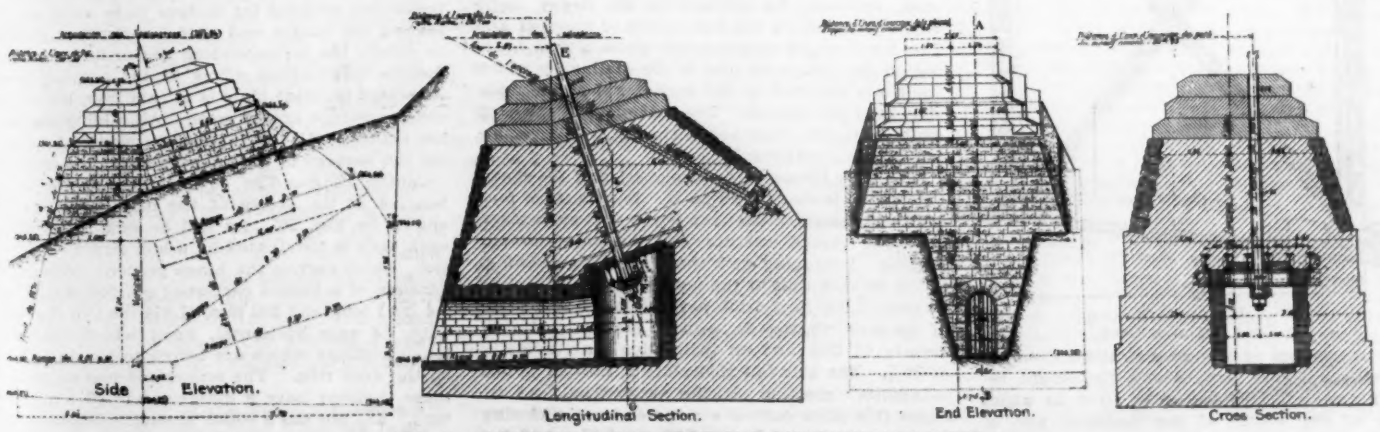

FIG. 3.—ELEVATIONS AND SECTIONS OF SKEWBACK PIERS.

Top Chords.—The top chord of each arch rib is horizontal, and its construction is shown in detail by Fig. 5. This member has an inverted U-section made up of a cover plate, and two side plates connected and stiffened by angles. The cover plate is made continuous, but the side plates are broken at each panel point to provide for the connection of the web posts and diagonals and their bracing. The depth of the side plates is 0.789 m. (2.58 ft.) at the panel points, directly above the skewback piers, and from these points it decreases toward the crown and toward the end of the cantilever shore arm to 0.49 m. (1.6 ft.). Between panel points the side plates are braced together at intervals by a cross-frame construction, and by lacing across the bottom opening. This bracing, and the manner of splicing the chords are shown by Fig. 5.

Bottom Chords.—In side elevation the bottom chord has a polygonal outline, with the sides of the polygon connected by arcs of 10 m. (32.8 ft.), where they meet at the panel points. In section this member is nominally U-shaped, the bottom plate and the two side plates being connected by angles, and similar angles being riveted along the top edges of the side plates, but for all but a few panels this U-section is converted into a box section by the addition of lacing plates or cover plates or both. The depth of the side plates of the lower chord and the sectional arm of the chord decrease each way from the skewback piers toward the crown and toward the end of the cantilever shore arm. Both the box and U-sections of the chord are braced interiorly by cross-frames of the contruction already described for the top chord, Fig. 5, and the top edges of the U-sections have a lacing like the top chord lacing, Fig. 5.

At the panel points the regular side plate construction is interrupted to permit the insertion of a gusset plate, to which the web members connect. This gusset plate is so inserted and reinforced that no weakening of the chord section occurs from its use. Fig. 6 shows the connection details and also the chord construction at one of the panels of box section.

Web Members.—The web system of the arch ribs is composed of (1) a set of members perpendicular to the top chord in the plane of the rib, and (2) a set of diagonals connecting the top of each perpendicular with the bottom of the succeeding one. These members are all of stiff section. Two types of sections are employed: (1) An I-section for posts 4 to 16 and 60 to 64, and for diagonals 2 to 18 and 58 to 66, and (2) a rectangular section for all the other web members except the end posts at the crown and shore end of each half arch rib. The I-section members are made up of two tees connected by a plate web for diagonals 2 and 66, and by a lattice web for all the others, and of cover plates riveted to the outside of the tees. Each tee is composed of two angles. As will be noticed the I-section is used only for the shorter and lighter web members. The construction of the diagonals and posts of rectangular section is shown by Figs. 7 and 8. The end posts at the crown are of U-section with the opening toward the hinge, and the end posts of the shore cantilevers are of box section. Both of these sets of end posts are made up of plates and angles.

Lateral and Sway Bracing.—The lateral bracing in the plane of the bottom chord consists of transverse struts between the feet of the opposite uprights connected by X-bracing, as shown by Fig. 4. At uprights 40 and 68 the transverse struts are of special construction; that at upright 40 being shown by Fig. 14, and that at upright 68 being a box girder having solid bottom and side webs and a lattice top web. All the other transverse

struts are either of I-section where they connect uprights of I-section, or of box section where they connect uprights of box section. Details of one of the box section struts are shown by Fig. 9. The X-bracing between these struts is made up of members of I-section in those panels where the web diagonals are of I-section and of members of rectangular section in those panels where the web diagonals are of rectangular section. Details of one of the X-members of rectangular section are shown by Fig. 10.

The sway bracing is located between the opposite uprights of the two arch ribs, as shown by

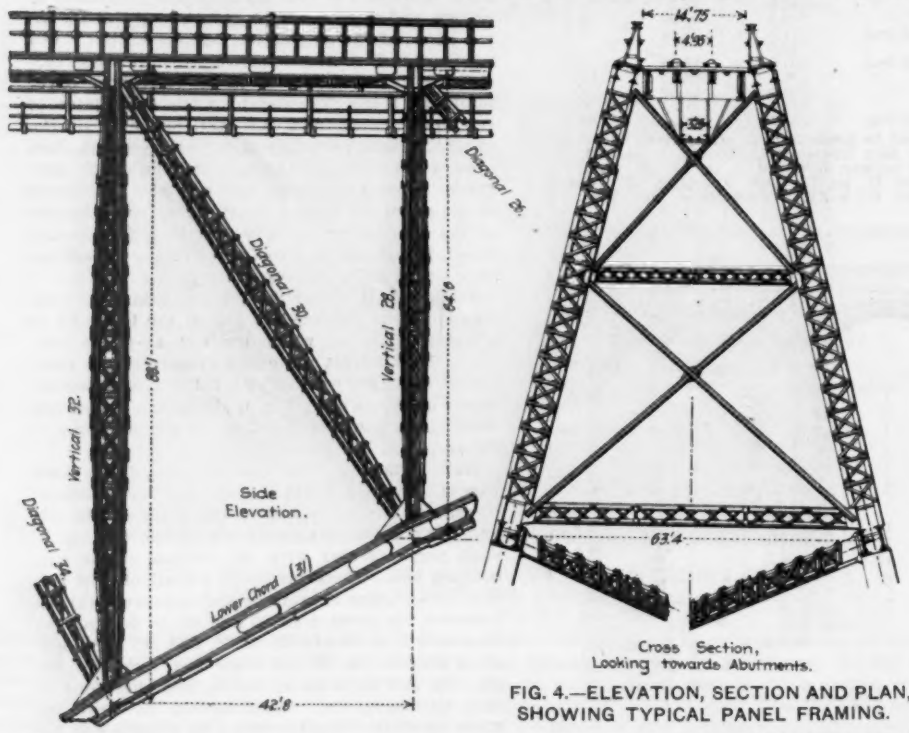

FIG. 4.—ELEVATION, SECTION AND PLAN, SHOWING TYPICAL PANEL FRAMING.

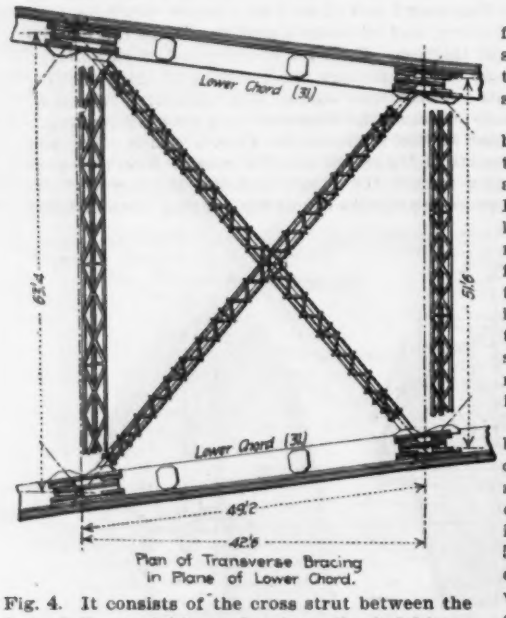

Fig. 4. It consists of the cross strut between the feet of the uprights, and, where the height requires it, an intermediate cross strut at about midway of the height of the uprights, and of X-bracing between the two struts and between the upper strut and the floor system. Where no intermediate strut is required the X-bracing runs between the bottom strut ends and the ends of the floor beams, and in the very end panels, where the height is small, this is further modified to an inverted V-bracing between the middle of the floor beam and the ends of the bottom strut. This diagonal bracing is made up of single channels or of channel and plate or angle and plate struts.

Floor System.—In the plane of the top chord the arch ribs are braced together by the floor system. This consists, first, of transverse box floor girders at each panel point constructed as shown by Fig. 11. The ends of each pair of main floor girders are connected by floor beams of the same depth as the girders. One of these floor beams is shown by Fig. 12. The floor beams are in turn braced together by cross girders of I-section, and these cross girders are connected by I-girder track stringers. Details of the connections of these various members of the floor framing are shown by Fig. 13. The floor framing carries a flooring of parallel trough sections spaced slightly apart and riveted to the main beams and to the track stringers. At three points, midway between the four lines of longitudinals the transverse trough sections are braced together by longitudinal trough sections riveted underneath. The track system rests on this trough flooring.

Skewback Panels.—The skewback panel members are necessarily of special construction owing to their duty of transmitting the weight of the arch ribs and their load to the skewback masonry. Fig. 14 shows this construction in detail, and very little further description is necessary. Attention may, however, be directed to the heavy angle forgings by which the web plates of the post and two lower chord members are given a firm bearing on the foot plate, and to the casting by which the rib is fastened to the anchor rod of the main skewback pier anchor. The foot plate of the arch rib is, of course, fastened to the upper hinge casting of the skewback hinge.

Skewback Hinge.—The construction of the skewback hinge is shown by Fig. 15. It consists of four castings namely, a base casting, a cast shim plate, a lower hinge casting and an upper hinge casting. Beginning with the upper hinge casting, it will be seen that at the top it consists of a plate 50 mm. (1.968 ins.) thick parallel to the foot plate of the arch rib, that is, with an inclination transversely of 25% and an inclination longitudinally of 30%. The plane of this plate is normal to the maximum reaction at the skewbacks. At its edges this plate carries a ridge or bead enclosing a bearing surface 1.7 m. × 1.26 m. (5.57 × 4.13 ft.) for the foot of the arch. A sheet of lead 5 mm. (0.196-in.) thick is placed between the foot plate of the arch and this bearing surface, and the two are fastened together by four 40-mm. (1.57 ins.) bolts. The top plate of the casting is connected by two transverse webs braced by longitudinal ridges or fins, to the hinge bearing plate proper. This hinge plate is a segment of a cylinder 1.56 m. (5.12 ft.) long, with a radius of 0.35-m. (1.15 ft.), whose axis is perpendicular to a vertical plane through the axis of the bridge. A hole passing through both the foot plate of the arch rib and the top plate of the casting provides for drainage.

The lower hinge casting is the converse in construction of the top hinge casting. The top plate is a concave segment of a cylinder 0.36-m. (1.18 ft.) of radius, into which the bottom convex plate of the upper hinge casting fits. This concave top plate is carried by two transverse webs braced by longitudinal ribs on a bottom plate 2 × [illegible] m. × 70 mm. (6.56 × 5.24 ft. × 2.75 ins.) in size. This bottom plate is horizontal. The two curved plates of the upper and lower hinge castings are pierced by two holes oblong longitudinally of the casting in which bolts are set loose. These bolts allow free radial motion to the curved plates, but prevent them sliding on each other transversely. The bottom plate of the lower hinge casting rests on a cast-steel bearing or shim plate.

The bearing plate is 1.86 m. (6.1 ft.) wide in the direction of the bridge axis, 2.15 m. (7.05 ft.) wide transversely to the bridge axis, and 50 mm. (1.96 ins.) thick. Around its outer edge, on top, this plate has a ridge or flange 45 mm. (1.77 ins.) high. Across its bottom, parallel to the bridge axis, the plate has on each side a ridge or flange 325 mm. (12.79 ins.) wide and 45 mm. (1.77 ins.) thick. These ridges seat the plate firmly on the base casting whose top surface is recessed to fit closely into it and prevent any sliding transversely. Longitudinal movement of the bearing plate on the base casting is prevented by two splines which fit between the transverse edges of the plate and the transverse flanges on the base casting. The bottom plate of the lower hinge casting rests directly on the bearing plate; it having its seat between the top edge flanges of the latter with a free play laterally of 20 mm. (0.787-in.) on all four sides. This is the only place in the skewback hinges where any lateral motion in respect to the skewback pier is permitted.

As already stated, the bearing plate seats on the base casting. This base casting is of iron, and owing to its large dimensions was cast in two pieces, which are fastened together by bolts. It consists of a top and bottom plate connected by transverse and longitudinal webs. The top plate is horizontal but the bottom plate is bent to fit the capstone of the skewback pier. A sheet of lead 10 mm. (0.39-in.) thick is placed between the bottom of the casting and the capstone, and the casting is fastened to the masonry by six 50 mm. (1.96 ins.) diameter holding-down bolts and by an anchor rod 130 mm. (5.12 ins.) in diameter anchored into the skewback pier, as previously described.

The top plate of the base casting is made with flanges around its top edges and is provided with transverse grooves for wedges to be used for adjusting the hinges and with longitudinal grooves to receive the corresponding ribs or flanges on the bottom longitudinal edges of the bearing plate. As stated the base plate is of cast iron, but all the other castings are of steel. All sliding surfaces are planed. All the casting are pierced by a hole for the passage of the anchor rod for the arch rib.

Center Hinge.—The construction of the hinge bearing at the crown of the main arch span is shown by Fig. 16. As will be seen the apex of each arch is terminated by a box girder construction, which carries the hinge proper. This hinge consists of a turned cast-steel pin 950 mm. (3 ft. 1.4 ins.) long and 200 mm. (7.874 ins.) in diameter with its axis horizontal, upon which bear two hinge castings which are bolted to bearing plates on the arch ribs. The semicylindrical sockets of these castings have a diameter of 205 mm. (8.07 ins.). The pin has a collar at each end and is also turned with two gudgeons by which it is anchored to the framing of the arch ribs. These anchors are practically short forged steel eye-bars, the eye ends of which slip over the gudgeons while the opposite end is flattened out and riveted to the side plates of arch ribs. There are two of these eye-bars at each end of the hinge pin, one going to each half arch rib. The minimum section of these eye-bars is 150×25 mm. (5.9×0.98-in.). Between the base of each hinge-casting and the bearing plate through which it is bolted to the end plate of the arch rib, there are inserted two wedges for use in adjusting the hinge.

Suspended Span.—The suspended spans which connect the ends of the shore cantilevers with the masonry approach arches require but little description. Their construction is quite clearly shown by Figs. 17 and 18. Each consists of two parallel Pratt trusses, with center panels counterbraced, divided into eight panels, each 3.4 m. (11.15 ft.). The length of the trusses end to end of chords is 25.92 m. (85.01 ft.),and their height back to back of angles is 3.16 m. (10.36 ft.). The trusses are spaced 5.1 m. (16.72 ft.) apart c. to c. and are braced together by the floor system, by a bottom lateral system, and by vertical sway bracing at each post. Referring to Fig. 8 it will be seen that each side of the suspended span is provided with a guard railing. These guard railings extend clear across the riveted superstructure, and are made of unusual strength for the purpose of keeping a derailed train on the bridge in the case of such an accident.

Structure for Inspection and Repair.—A notable feature of the Viaur Viaduct is the arrangement provided for making inspections and repairs to the steelwork. There is first a combined footbridge and tramway extending lengthwise of the bridge at the middle and just below the floor system. The location of this footway through the suspended truss spans is shown by Fig. 17. Along the remainder of the bridge the walk consists of two channel chords with angle floor beams and plate flooring suspended by hangers from the track stringers above and protected by a hand railing. Push-car tracks are laid on the floor of this foot path. Along each lower arch chord there is a stairway 0.4 m. (1.312 ft.) wide, protected by a hand railing and following the curve of the chord. At each web member of both arch ribs except Nos. 0 to 14, 18 and 20, 56 to 62, and 66 and 68, there is a ladder 0.4 m. (1.312 ft.) wide. At the very long uprights Nos. 32 to 48, these ladders are provided with rest landings carried by brackets at intervals in their height. Finally, at uprights, Nos. 16, 32, 44 and 64, the upper rest landings are connected by cross walks with the center longitudinal footway. Fig. 19 shows the details of this last arrangement.

Cost.—The total cost of the Viaur Viaduct, not including cost of superintendence, tests, etc., was 2,452,105 francs, or about $490,421, of which 234,203 francs, or about $46,840, were for masonry, and 2,217,901 francs, or about $443,580, were for metal work. The additional expense for superintendence, tests, etc. are estimated at 247,894 francs, or about $49,578, making the entire cost of the structure, complete, 2,700,000 francs, or about $540,000.

For the information from which this description has been prepared, we are indebted to Annales des Ponts et Chaussees for the fourth quarter of 1899. The accompanying illustrations have been redrawn from engravings which were published in the same periodical.

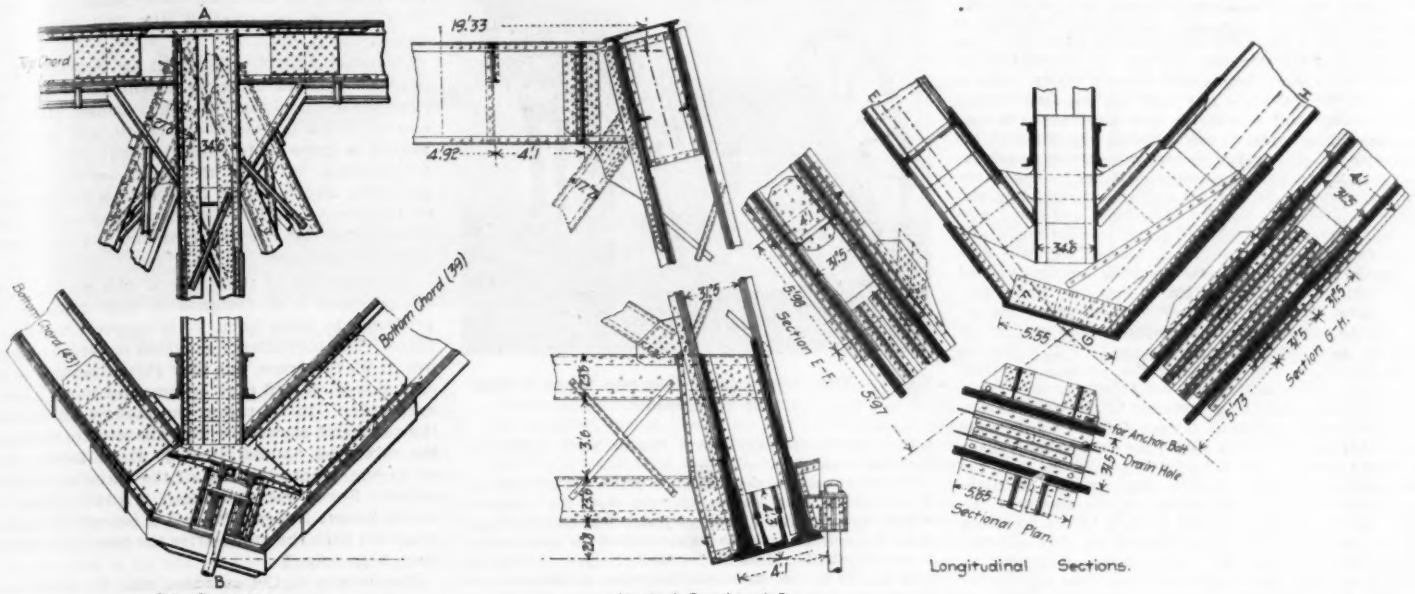

FIG 14.—DETAILS OF PANEL POINT FRAMING FOR SKEWBACK PANELS.

REGULATION IN LONG-DISTANCE POWER TRANSMISSION BY ELECTRICITY.*

By Frederic A. C. Perrine, D. Sc.†

When we speak of the regulation in an electric plant of any kind, it is common to refer only to the maintenance of the proper voltage at the lamps or the motors of the customers; but in order to obtain a proper regulation for the customer it is necessary in the design of the plant to consider regulation at many different points. In the first place, the periodicity of an alternating-current supply, must be maintained constant, which means that the water-wheels must have regulators which will maintain a constant speed irrespective of changes in the load and changes in the voltage. In the generators, the regulation is one of voltage, and this must vary with varying load even though the customer may require a voltage as constant as the periodicity. The step-up transformers in the generating station are one of the factors which determine the amount of voltage variation which the generator must provide, and in the line we find a disturbing element that must be carefully considered. The final adjustment of the voltage to suit the customers needs is provided in the sub-station where the step-down transformers are located.

The regulation of water wheels is effected in a different manner with high and low head wheels. With wheels operating under a low head, large penstocks in which the water moves, at a low velocity are generally available, and, in consequence, regulation of such wheels is always provided by variation of gate opening. This system of regulation, while certainly difficult to accomplish on account of the weight of the moving parts, is ideal in respect to conservation of water, the water allowed to flow being in some respect proportionate to the load. We say "in some respect," on account of the fact that the efficiency of all water wheels falls very materially as the load decreases. This difficulty of efficiency variation produces a difficulty in regulation, for the reason that a certain load change at full load requires a smaller gate variation than the same load change at one-quarter load. In order to surmount this difficulty, a recent Italian designer has attempted to close bucket openings instead of gate openings in his wheel, thus operating certain buckets always with full volume of water and maintaining full bucket efficiency at all loads.

Such wheels have not been built in this country, although a set has been contracted for by the Montmorency Electric Power Co., at Quebec, where the wheels under this design are now being installed.

The good regulating points of the low head wheels are sacrificed whenever the velocity of flow or the length of the penstocks is increased, and their regulation is correspondingly improved by shortening the penstock, even to its entire obliteration, and operating the wheels in the forebay itself. However obvious this may seem, it is nevertheless the fact that in an Eastern plant recently installed, and not yet in operation, the engineers have led the water from the forebay through 100 ft. of entirely unnecessary penstocks laid level.

In a high head plant, the penstock, instead of being short and of large diameter, is long and of comparatively small diameter, with the water velocity rising as high as 12 to 15 ft. per second. Here any attempt to regulate the wheels by varying the flow of water produces fluctuations in the pressure which are not only dangerous, but disastrous to regulation. Any attempt to close the gate at the end of a long pipe in which the water is flowing at a high velocity is resisted by the water within the pipe with a tendency to momentarily maintain the same energy without much reference to the size of the opening. The effect of varying the opening in the water gate is to vary the velocity of the water flowing through it, and, as the energy is equal to one-half the mass times the velocity squared, the variation of velocity tends to maintain at a constant the energy imparted to the wheel in spite of the variations in the mass. In a station operating more than one wheel from the same pipe line, this effect is distributed among all the wheels running. It is often possible by closing one gate partially, to speed up all the wheels for an instant, and the wheels only attain the proper speed due to the reduced opening after they have been subjected to a series of impulses from the surging water within the main pipe. In one case to which the attention of the writer was called, where wheels were operated under about 250 ft. head, closing of a single gate at the power house would cause the water to rise in the forebay as much as 10 ft., which rise was accompanied by variations in pressure equal to about 10% of the full pressure at the power house. Furthermore, it is hardly to be conceived that any throttling nozzle that has been devised can prevent leakage and prevent eddies of water on the back of the bucket, producing disturbances of the speed regulation. In consequence of these facts, it seems to be the clear conclusion that regulation of high head wheels can be best obtained by a system which does not disturb the flow of water in the pipe line, which points either to the deflecting nozzle or the deflecting hood, and while we have no tests of the two systems which are thoroughly reliable, it certainly seems that the undistorted stream from a deflecting nozzle should give higher wheel efficiency at partial loads than will the distorted stream produced by a deflecting hood.

If either of these systems is to be used, the plant should be so installed as to reduce the wastage of water at partial loads as far as possible, since, of course, with a deflecting nozzle or deflecting hood, the flow of water through the nozzle is always constant. Such a sub-division, therefore, of the water-wheel units is necessary as will allow cutting out entire wheels when the load shall vary materially. It is not advisable to install such small generating units as this system of regulation seems to entail; but the same result can be obtained by a multiplication of the number of wheels attached to each generating unit. Up to the present time no more than two wheels per generator have been installed in any high-head plant, though in certain low-head plants as many as five or six wheels have been attached to one generator. Should high-head plants be installed with as many wheels as this, the cost of the entire plant could be kept down by increasing the speed of the generators very materially. In fact, for units as large as 1,000 K-W., a speed of from 600 to 1,000 revolutions should be readily attained and the cost of such a plant with five or six wheels on the generator shaft would not be greater than the cost of a plant with one wheel running at about 200 revolutions attached to a generator of the same capacity.

*Abstracted from a paper read before the Pacific Coast Electric Transmission Association.

†President Stanley Electric Mfg. Co., Pittsfield, Mass.

When we pass from the water wheel to the generator, we find that while the water wheel must regulate for constant speed, the generator, which is operated at the constant speed of the water wheel, must be adapted for variable voltage regulation. In drawing specifications for generators it is far more common to demand extreme self-regulation as regards constant voltage than it is to demand a possibility of great voltage variation, whereas in the generating stations the machine must necessarily be varied in voltage even though a constant voltage be demanded by the customer, and in consequence, machines that are designed for self-regulation at constant voltage are not generally satisfactory in long-distance transmission plants. This is especially true on account of the fact that it is customary to measure the regulating properties of the generator on a non-inductive load. A non-inductive load in a long-distance transmission plant is an impossibility, for even though the plant be used only when furnishing a non-inductive load, as of incandescent lights, the lines and transformers introduce at the generator a reactance which must be taken care of by the design of the machine. Indeed, the extremes of reactance are always encountered in such plants, since at low loads the long lines will make the generator current lead; at high load it may lag very materially. In consequence of these facts, the inductive regulation of the generator as such must be as high as possible, though the ohmic resistance of the machine need not be necessarily low, as would be the case for a close self-regulating machine operated on a non-inductive load; and many generators acceptable in ordinary power stations are unsatisfactory in long-distance plants, because they will vary in voltage greatly when inductive loads are applied, and they have not sufficient margin of field capacity to permit of over-excitation necessary for overcoming the effect of the lag factor. In consequence, the capacity of both the field and the armature must be higher than is commonly allowed, or else under the common conditions of running, the machines will not be able to use within 10 or 15% of the full energy delivered by the water wheels.

It is not often acceptable in long-distance transmission plants that the generators should have a possible voltage regulation equal to the full amount of the line loss, but they must be designed to permit from two to three times the voltage variation determined by the losses in the lines. It may seem anomalous to state in the beginning that the machines need not be designed for close self-regulation and in the end that their inductive drop must be smaller, but when it is remembered that close self-regulation may be produced by low ohmic resistance, which is unnecessary for small inductive drop, the anomaly is explained.

The same observations are true of the step-up transformers. The only essential difference between the transformer effect and the generator effect is that while the regulation of the generator on non-inductive load can be about one-third the regulation of the transformers on an inductive load, it seems to be impossible to design a generator with more than one-fifth the regulation of the best transformers Furthermore, as the generator must compensate for the voltage regulation, both within its own coils and also within the coils of the step-up and step-down transformers, as well as throughout the whole line, it follows that the transformers should be designed to relieve machines as far as possible of great necessity for variation as the inductive effect of the load changes. In consequence, the specification of the inductive drop through a transformer is, in general, more important than a specification of the non-inductive regulation.

Perhaps the worst disturbing effect of all is to be found in the line itself. Here we have not only an inductive drop, but also a heavy capacity current, the capacity current remaining practically constant at all loads while the inductive drop varies with the load. The question for the proper disposition of the line to have the capacity current from the line counteract entirely the various reactances throughout the circuit, is a very alluring one and has been tried by many designers; but as the capacity current remains constant while the reactance continually varies with the load, it is impossible to so adjust the line in height above the ground and distance between wires as to effect any serviceable self-regulation. If self-regulation consisted in the maintenance of a constant voltage at a constant load, the line might be so designed as to aid in producing this effect, but as the load falls the importance of the leading current in the line becomes greater, while as the load rises its importance diminishes, in both cases disturbing the voltage and demanding from the machine a wide range of possible manual regulation. Until recently, the exact effect of the line as regards both capacity and inductance, proved to be a difficult problem for solution, though, of course, the solution could be accomplished by several methods on devoting a sufficient amount of time. The line itself limits the amount of power that can be transmitted to a great distance, for the reason that for a line of about 100 miles in length, with voltage between 40,000 and 50,000, from 1,200 to 1,500 kilovolt amperes must be used in charging the line—unless reactance coils are used—and, in consequence, an amount of power less than 3,000 HP. cannot be satisfactorily delivered such a distance. Even where the selling price of power is enough to counterbalance the cost of the line of such a length, the large capacity current makes any feasible system of regulation almost an impossibility with a smaller amount of power to be delivered.

By the use of reactance coils at the sub-station, the generator current at no load can be made very small, and I believe it will pay to put in reactance coils on long lines, not only to reduce the generator current and line loss at no load, but as sub-station voltage regulators. If half the charging current be neutralized, the lower limit given for the power that may be transmitted over a 100-mile line will be reduced one-half. I believe the proper way to regulate the voltage at the sub-station is by the use of adjustable reactance coils and a compensated voltmeter at the generating station. In any case, feeder regulators should be put on the feeder circuits, but no regulators on transformers, especially where two or more banks are operated in parallel.

Fig. 1.—The "Dromedary" Concrete Mixer in Position for Loading.

Finally we come to the regulation within the sub-station. A sub-station must deliver voltages that are constant within short periods, at the very least. The customer may demand a voltage variation on account of the losses within the distribution lines as his load changes, but during such periods as the customer's load remains constant, the voltage must remain constant. The fact that his voltage may change with his load demands some system of manual regulation within the sub-station, and because the generator will necessarily alter its voltage with an alteration in the character of the load, irrespective of its size, it is not generally safe to install a sub-station system in which at least 25% voltage variation is not, in the extreme cases, possible.

To summarize, it is the writer's opinion that the following points are somewhat new and demand careful consideration:

1. The subdivision of water wheels and the use of extremely high-speed machinery.

A wide range in the possible voltage variation in the generators, with generators and transformers both designed not for good non-inductive load regulation, but for good inductive load regulation.

3. Lines designed for the smallest possible capacity current without reference to any attempt at balancing the line capacity against the load lag.

4. The use of reactance coils at the sub-station (instead of regulator heads on transformers) and wide range of regulators in feeder circuits.

CHARGING MACHINES for open-hearth furnaces have been installed at the Phoenix Iron Works and it is found that the machines working on six furnaces dispense with the labor of about 80 men. The machine used is that invented by Mr. S. T. Wellman, M. Am. Soc. M. E., of the Wellman-Seaver Engineering Co., Cleveland, O.

A TRAVELING CONCRETE MIXER.

With the great increase of the use of concrete in recent years, inventors have turned their attention to machinery for its preparation; and the standard and well-known machines for this purpose are now supplemented by a number of ingenious contrivances, many of which have been illustrated in these columns. Decidedly the most novel apparatus in this line which we have ever seen, however, is that which is illustrated in the accompanying cuts. It has been christened the "dromedary" mixer, not, we believe, with any intention of disrespect to the beast which furnishes the motive power, but because the two halves of the concrete carrying case, as they lie inverted on the frame after dumping, can be made to resemble, with a good imagination, the two humps of a camel.

The idea of the mixer will be evident at a glance. Instead of using steam power to churn the concrete in a box, like the common mixer, the box or drum is placed on wheels and is so connected to them as to slowly revolve while a horse is drawing it from the place where the ingredients are piled to the place where the concrete is to be used. The accompanying half-tone views show the machine with the mixing drum in different positions.

The capacity of the drum is 21.6 cu. ft., or 0.8 cu. yd., and it is designed to hold sufficient ingredients to make ½ cu. yd of rammed concrete in place. The ingredients shoveled in separately will nearly fill the drum, but they shrink rapidly as the cart moves off and they become incorporated with each other. In operation the makers advise that the sand and cement be first shoveled in and then the mixer be hauled 50 to 60 ft. or more to the stone pile, where the rest of the materials may be added. For a wet concrete it is advised that the water be put in first; for a dry concrete it should be added with the stone after the sand and cement have been mixed.

The details of the machine may be understood by reference to Figs. 4 and 5. The drum can be opened either by the trap door, for filling, or by separating in two halves for dumping. When the trap door is opened, the drum goes out of gear with the carrying wheels, so that the mixer may be moved about as desired for convenience in loading. Closing the trap door throws the drum in gear automatically; and it is then ready to start off and mix its contents as it goes. In case of a hard pull or of the horse becoming stalled on the way to the dumping place, the driver can throw the mixer out of gear temporarily.

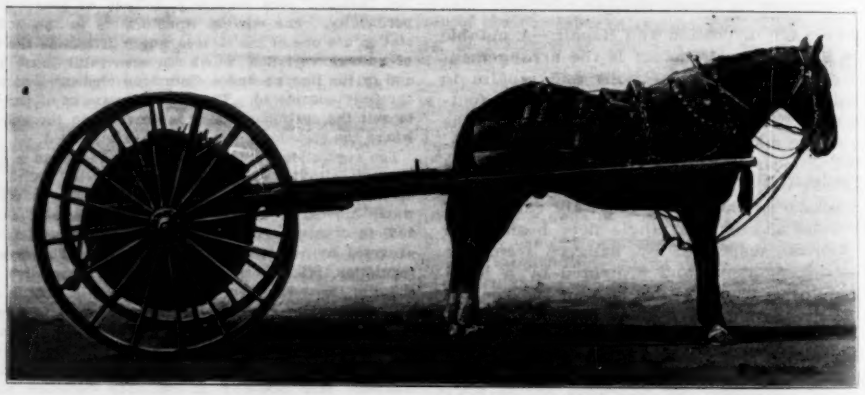

FIG. 2.—THE "DROMEDARY" CONCRETE MIXER LOADED, CLOSED AND READY TO MOVE.

At the point where it is desired to dump, the driver raises a lever and releases an unlatching bar which opens the latch holding the two halves of the drum together, and it at once dumps its contents and at the same time automatically goes out of gear. This is all done without the horse or driver stopping. To close the drum the driver gives a pull on cleats on the back of one of the inverted sections and the two halves close and automatically lock the drum out of gear at the same time, so that the horse goes back to the loading place with the drum stationary. Numerous useful hints regarding the methods of operating the mixer and its most convenient application are

given in a neat pamphlet just issued by the makers of the mixer, Messrs. Fisher & Saxton, 123 G St., N. E., Washington, D. C.

It will be apparent that this type of mixer finds its most advantageous application on street work, where it dispenses with the swarm of hand shovelers, the wheelbarrow brigade and the mixing platforms, usually employed on such work. The mixer was in fact developed as a result of experience in the construction of electric conduit railways in Washington, D. C. Mr. E. Saxton, of the above-named firm, is a contractor of large experience in the construction of cable and electric conduit railways, and in the first development of the "dromedary" mixers he used them for over 20,000 cu. yds. of concrete on conduit railway construction in Washington. They have since been successfully used for numerous other classes of street concrete work and are claimed to be advantageous in all concrete work, with the possible exception of work so large that it is desired to dispense with shoveling so far as possible and discharge materials from storage bins directly into a stationary mixer.

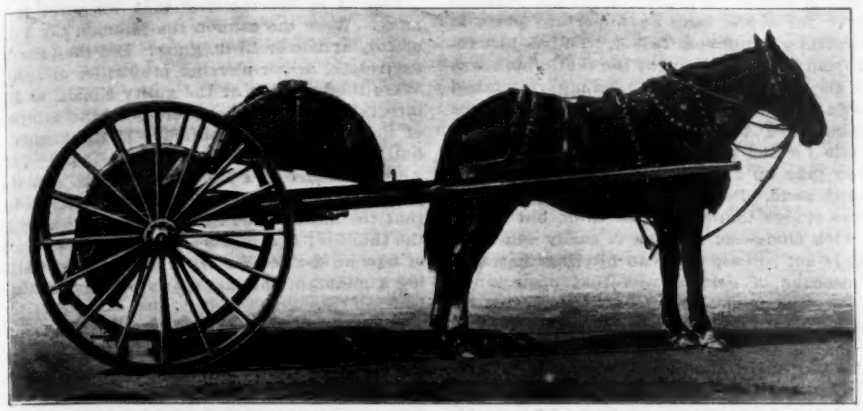

FIG. 3.—THE "DROMEDARY" CONCRETE MIXER IN DUMPING POSITION.

The quality of concrete made with the mixer is claimed to be the very best, and with proper care in proportioning the materials there seems every reason to believe that the machine should give perfect satisfaction in this respect.

The machine is the invention of Mr. Isaac H. Fisher, and is patented in the United States and foreign countries. We are indebted to the manufacturers, named above, for the photographs from which our illustrations are reproduced.

THE POWER CONSUMPTION OF ELECTRIC CARS was the subject of a paper recently read before the English Society of Engineers by Mr. A. H. Binyon. The following figures are for 12-ton cars at speeds of 6 to 12 miles per hour and with stops of 8 to 10 seconds:

Miles per hr.	No. stops per mile.	K-W.hrs.per car-mile.	Miles per hr.	No. stops per mile.	K-W.hrs.per car-mile.
6	6 to 14	.7 to 1.08	10	4 to 8	.82 to 2.2
7	6 to 13	.65 to 1.43	11	4 to 7	.78 to 2.04
8	5 to 11	.75 to 1.75	12	3 to 6	.73 to 2.04
9	4 to 9	.73 to 2			

THE NEW 18-IN. GATHMAN TORPEDO GUN, for the construction of which Congress appropriated $65,000, was recently tested before a board of army officers at the Bethlehem Steel Works. Before the gun will be accepted ten shots must be fired with a pressure of 18,000 lbs. per sq. in. and a velocity of 1,800 ft. per second. In the test already made four shots were fired, the pressures being above 19,000 lbs., and the velocities about 1,900 ft. The remaining six shots will be fired this week. The gun is intended for coast defense, and will throw a shell containing wet gun-cotton. It is 44 ft. long and weighs 50 tons.

GAS FROM WOOD is produced by a new process, invented by H. Riche. When wood is distilled in the ordinary way it breaks up into various gases and condensable vapors and charcoal. In the Riche apparatus the volatile products are caused to pass through a bed of red-hot charcoal, which breaks up the more complex products. The retort is a steel cylinder which at the beginning is partly filled with charcoal, upon which is piled the material which is to produce the gas. The retort is heated by an external fire, and since the only outlet for the gases is below the charcoal, all products of distillation must pass through the latter. It is said that one ton of wood chips gives 28,000 cu. ft. of gas and 400 lbs. of wood charcoal; 900 lbs. of wood being used as fuel in the external furnace. It appears that a device of this sort might be applied to obtain gas from refuse or garbage.

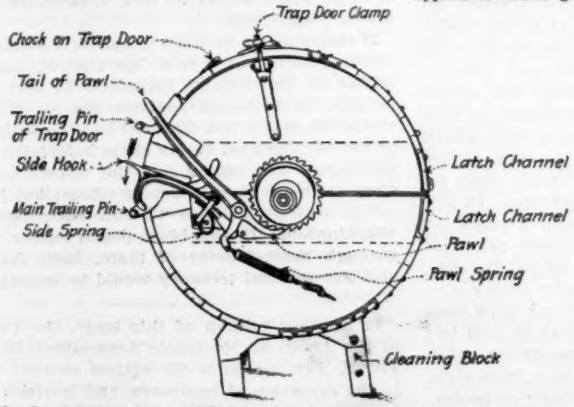

FIG. 4.—DRUM OF "DROMEDARY" MIXER IN CLOSED POSITION.

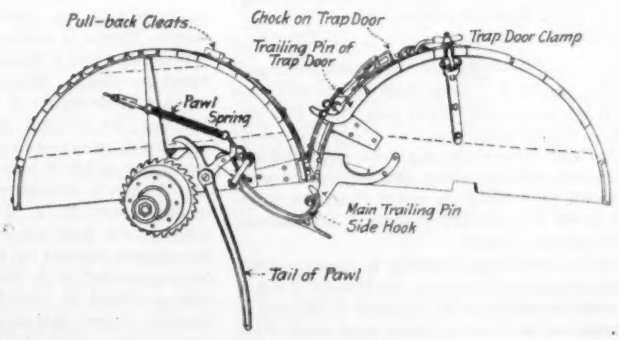

FIG. 5.—DRUM OF "DROMEDARY" MIXER IN DUMPING POSITION.

ELECTRO-GALVANIZING is being used in England for the protection of boiler tubes. The Admiralty specifies that all boiler tubes must be coated externally with a coat of zinc equal to 1¼ ozs. per sq. ft.

CREEPING OF RAILS ON THE ST. LOUIS BRIDGE.

The abnormal amount of creeping of rails which takes place on the double-track line crossing the Eads arch bridge over the Mississippi River at St. Louis, Mo., has been a matter of observation for many years. It was reduced some years ago by laying the rails on ties instead of upon the independent wooden blocks originally used, but the flexibility of the bridge spans will always accentuate the influence of the elasticity of the track itself. The bridge proper has a rise of 5 ft. at the center of its length of 1,600 ft. The east approach is on a curve, and is a steel viaduct 2,500 ft. long, with a grade of 1.56%, and here the creeping was excessive until the viaduct was rebuilt in a more substantial manner. The west approach is an embankment, and the track upon it gives little or no trouble. The force exerted by the creeping rails is sufficient to fracture splice bars and ⅞-in. bolts, and to drive a 70-lb. rail round a curve of 5¾°, and straighten it again on the tangent beyond. Means are provided to allow the rails to creep without injury to the track or the structure. At each end of the bridge proper is a double crossover, and as these must be maintained permanently in position special creeping devices have been established. There are eight sets of these devices, four in each track. They are situated at the east end of the east approach viaduct, at both ends of the crossovers on the east side of the bridge, and at the east end of the crossover on the west side. At each of these places, two switch rails are placed in the track, and the main rails pass outside of these switch rails, which are firmly anchored to steel plates on the ties, and have guard rails with a flange-way of 2 ins. When a main rail has nearly pulled past the switch rail, another is coupled on to it; while a rail that has pushed through is uncoupled and taken back to the other end of the section, where it is again put in the track.

From Mr. J. W. Taylor, Chief Engineer of the Terminal Railroad Association of St. Louis, we have received the following recent record of the creeping on the four lines of rails, the rails being numbered from the north to the south side of the bridge.

Creeping of Rails on the St. Louis Bridge.

	Rails							
	No. 1.		No. 2.		No. 3.		No. 4.	
Bridge:	ft.	ins.	ft.	ins.	ft.	ins.	ft.	ins.
November, 1899	18	2	20	10	22	8	17	8
December, "	23	4	26	3	28	8	42	3
January, 1900	19	5	22	9	27	2	20	7
February, "	21	1	22	4	..	..	..	..
March, "	17	1	19	9	..	..	..	..
April, "	17	7	21	4	5	8	2	11
May, "	10	5	15	4	5	8	3	0
June, "	9	2	9	3	9	1	5	8
July, "	9	2	7	4	13	6	11	8
East approach:								
November, 1899	32	2	44	5	36	10	42	5
December, "	38	4	57	7	45	8	57	6
January, 1900	38	0	57	2	46	0	57	2
February, "	34	2	52	2	43	6	57	5
March, "	38	4	50	7	45	5	53	5
April, "	8	9	13	2	36	1	41	4
May, "	23	8	28	1	33	9	41	7
June, "	28	2	43	3	35	9	39	6
July, "	32	10	39	4	38	2	40	7

It will be noted that on the east approach there was quite a variation in the amounts on rails No. 1 and No. 2 for the months of April and May. This is accounted for by the fact that rails were relaid about the first of May, and on account of being newly spiked and bolted they were held in place more securely than the old rails. The same explanation will apply to rails No. 3 and No. 4 on the bridge proper during April, and to rails No. 1 and No. 2 during June. On account of the curves on the east approach the rails wear very rapidly on the outside of the curve, and consequently the outside rails are changed much more frequently than the inside rails. This, of course, gives a difference in the record of creeping, and for this reason it is very hard to obtain any record that will show a variation in creeping exactly in proportion to the traffic. The tracks upon the bridge proper were relaid during April and June, 1900, and as the conditions are the same for each rail, the record on this portion of the track can be relied upon much better than the record for the rails on the east approach, where the rails of each track have not been in place for the same length of time.

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ADVERTISING RATES: 20 cents a line. "Want" and "For Sale" notices, special rates, see page XXIII. New copy for standing advertisements should be received one week in advance of publication; new advertisements, Monday morning. The pages containing "Want," "For Sale" and "Proposal" advertisements are held open until Wednesday noon.

The fatal rear-collision on the Philadelphia & Reading Ry. on Sept. 2 adds another to the long list of serious disasters which this road has experienced. Newspaper reports of the accident make clear that where the accident occurred the trains were run with no other precautions to keep them spaced a safe distance apart than the time-honored (or let us say more truly, time-dishonored) "five-minute rule."

According to this "rule," which it appears from this accident is still in force on the Philadelphia & Reading, station agents are required to display a danger signal as soon as a train goes past their station and leave it displayed for five minutes. The train may be stopped from one cause or other just out of sight round a curve, or at a local station a short distance away, as happened in this last accident. The station master has no knowledge of this, however, and the red flag comes in at the end of five minutes—perhaps sooner, if his other duties happen to be pressing. The next train comes along, finds no warning displayed and rushes onward to the chance, at least, of disaster.

The fact is that the "time interval system" of operating trains is inherently defective. It has cost many thousands of lives in the years it has been in use in the United States, and will count additional victims so long as it is adhered to. It is no merit for the system that it works all right for a thousand or for ten thousand times. The one failure comes often enough, and is so serious in its results that the system stands condemned by the test of experience.

It should be clearly understood, therefore, that from the public point of view it matters little whether the engineer, the operator or the train dispatcher was the one chiefly at fault in bringing about this latest railway horror. The real culprit is the system which puts men in positions where failure is so likely to occur.

It is fortunately true that great progress has been made in the introduction of the block system or space interval system of train movement on American railways during the past decade. Such object lessons as the Hatfield disaster ought to accelerate its introduction.

The septic tank seems to be gaining steadily in favor, both in this country and England. Certainly it is arousing a great amount of interest both sides of the water. At the meeting of the American Society of Municipal Improvements, last week, a number of papers on sewage purification gave the septic tank an important place in their contents. Professor Talbot, who has just returned from England, thought the septic tank was leading the contact beds as a preliminary method of sewage treatment. On the face of it, this seems reasonable since it is a little odd to build a large receptacle for the anaerabic bacteria to work in and then take up half or more of the space provided with sand. Possibly the contact bed would leave less sludge than the septic tank, but in the latter, such sludge as remains is easily removed, while it is not so easy to clean filtering material. The consensus of opinion was that open tanks are as effective as closed, unless, as suggested by Professor Talbot, variations in temperature have to be considered. He thought these variations would be far more significant here than in the milder climate of England, but it seems probable that they might be ignored in many sections of America. Anyhow, if temperature effects, or these and possible odors, are the chief reasons for covering septic tanks, the roofing may often be less expensive than would be required to exclude air. Much yet remains to be learned regarding the septic tank, and there is no little danger that it will become a fad during the next few years and be installed with little care to see that it is designed to meet local conditions.

Another important topic discussed by the society named above was the maintenance of paved streets. Mr. Kemmler, of Columbus, O., hit the nail on the head when he said that scarcely an American municipality knows what street maintenance is. Millions are expended on construction to hundreds for intelligent repairs and maintenance. There is scarcely an American city whose streets are not a disgrace through failure to keep them in repair. Engineers are pretty well aware of this, although not as much so as they should be, but the general public slumbers on while its expensive pavements go to rack and ruin. In line with this subject was the discussion aroused by Mr. Fisher's statements as to certain practices in Rochester, N. Y. He said that all paving contractors are now made responsible for damages to pavements caused by new underground work contemporaneous with the paving. That is, just before a street is paved it is customary to order sewers, water mains and connections therewith. Often this work is done by the paving contractor. If not, he is responsible for any poor work done by some other contractor; thus both the city and the paving contractor inspect back-filling of trenches and similar work. As engineering departments of most cities are constituted, it is difficult, if not impossible, to ensure thorough inspection of back-filling. This plan makes the paving contractor pecuniarily interested in proper work. Some members thought the practice was unduly hard on the paving contractor and altogether too easy for the city; but however this may be regarded, certainly there ought to be a change in the manner of putting in underground work if street pavements are to be maintained in an economical and sanitary condition, to say nothing of being so kept that they may be used with any degree of comfort.

"Shooting Cannon at Clouds in France" is the title of a recent official report from the U. S. Consul at Lyons, France, which has been published by the Government and extensively reprinted in the newspapers. The consul states that experiments are in progress in his vicinity to dissipate hail storms by firing cannon at the clouds, and he gives details as follows:

> Fifty-two cannon, manned by 104 cannoneers and their chiefs, have been distributed over an area of 2,500 acres of rich vine land. For the expense of the experiment, the Government appropriated $386, the department council $289, the National French Agricultural Society and a number of wealthy wine growers added $2,316 and furnished 14 more cannon. I translate the report of the first firing at the storm clouds this season:
>
> "The farmers of Denice were aroused at 1.30 o'clock on the night of June 5-6. The storm was very severe. The artillerists, from 40 to 50 strong, fired their guns and stopped the thunder and lightning. In the neighboring communes, the people saw columns of flames rise 200 ft. above the cannon when the shots were fired. At several places, women recharged the cartridges."
>
> I am told that the practice of shooting at the clouds was known in France over a hundred years ago, and that it originated in Italy. It is to be more extensively used on this year than ever before.

This is so entertaining that we want to hear more. Were the cannon the common toy Fourth-of-July article or 13-in. guns? Did they fire blank cartridges, armor-piercing projectiles or canister? Were they pointed at the guilty clouds, or in any direction that the local prejudices and sympathies of the firing party dictated? If the clouds were hail clouds, what became of the hail? If they were "thunder and lightning" clouds, can we explain the success of the experiment on the theory that the noise of the cannon drowned the noise of the thunder? It reminds one of Mark Twain's story of how he soothed the fears of his better half during a midnight thunder storm by ringing a dinner bell.

The most puzzling thing about the whole matter, however, is to explain why artillery discharges should scare away clouds in France, whereas in the United States those pseudo-scientists who believe in weather-making schemes aver that the same operation will cause clouds to form and drop down their burden of moisture. Surely the famous Government expedition to Texas and the alleged showers that followed the labors of "Cloud-compelling Dyrenforth" and his assistants cannot be forgotten!

Speaking seriously, is it fitting that the United States Government should spend time and money in collecting and publishing such absurd nonsense as the above-quoted official consular report? Is it any part of the Government's business to furnish "fake" sensational stories to the daily papers, most of which betray no lack of facilities for supplying themselves?

If this were an isolated example, it would not be worth notice; but it is a fact that at least nine-tenths of the reports furnished by our foreign consuls on technical matters are so absolutely worthless that it is a discredit to their authors and to the Government to lay them before the public. Of course, one cannot look for expert qualifications in the average consular officer; but it ought to be entirely feasible to edit their reports at Washington. If the blue pencil were drawn through three-fourths of them, both the public and the national treasury would be benefited.

In another column of this issue, the President of the American Economic Association, Dr. Richard T. Ely, presents the claims of that Society to the attention of engineers, and invites them to become members. The society has done a large amount of useful and valuable work during the fifteen years since it was organized, and emphatically deserves the support of public-spirited citizens. That a broader knowledge of economic science—the laws which govern our present industrial system—is one of the greatest needs of the present day, every intelligent man will admit. We do not now recall any agency that is doing more straightforward work to bring this about than the American Economic Association. Engineers are as a class interested—many of them very vitally interested—in the field of economic research. Their interest is from the practical side, it is true, rather than the theoretical; but they can do all the more valuable work in the association on that account. Prof. Ely's invitation will receive, we trust, many responses from our readers.

THE FUTURE OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

Some questions were raised in private discussion at the meeting of the American Society of Municipal Improvements, last week, regarding the future of that organization. The convention was the seventh annual meeting of the society and was

considered by those in attendance as both profitable and enjoyable. Yet it was noted that the total registration, including guests, was only about sixty; that at several sessions there were only from 15 to 25 in the hall; that most of the committee reports were really the work of one man; that several committees supposed to include three members had been unable to secure or hold more than one member; that many of the committees reported a general failure of members and others to respond to requests for information or criticism; that there was comparatively little discussion of the reports and papers; that several cities largely represented heretofore had no one present this year; and that most of those in attendance and prominent in the proceedings were city engineers, or engineers in private practice, rather than superintendents of sewers, water or lighting plants, or commissioners of public works. While these various observations seem discouraging, when grouped, no one suggested that the society was on the decline or predicted its failure. In fact, there were several very hopeful expressions of opinion that it would have a bright and useful future. That there is need for a society devoted to municipal improvements all agreed, although one member suggested that inasmuch as there are so many water-works associations in the field, this branch of municipal activity might be left to them. All the reflections noted, it should be remembered, were made in private.

While we believe that the American Society of Municipal Improvements has done and is doing much excellent work and may do even more in the future, we think it would be well for its officers and members to observe and act on some of the unmistakable signs of the times. The last remark is equally applicable to a number of other societies, whose membership and achievements fall far below their possibilities and the crying needs of American municipal government and public works. It is painfully evident to anyone who attends many engineering and allied conventions, particularly those holding meetings but once a year, that their effective work has been carried on for years by a comparatively few men and that those men are bending, or have broken, under the strain, particularly with the multiplication of new societies, each with its urgent demands on time, strength and pocket-book. The committee work of the society immediately in question is evidence of this. Most of its important working committees had only one member in service this year, where they should have been three, and most of these solitary chairmen have been unsupported by the members at large, as well as by fellow members on the committees. The failure to secure full committees and of members at large to respond to inquiries, and the comparatively small attendance at the convention, seems to afford evidence that not only the leaders, but the whole body of the membership, are bowing under the demands of so many different societies.

To be more specific, the Committee on Municipal Data consisted of the chairman, alone, all last year, and reported that although it presented schedules designed to secure uniform reports in various lines, two years ago, practically none of the members had responded to the request for criticisms of the forms. The Committee on Garbage Disposal sent out 44 requests for information, and the eight persons who replied at all did so only to decline to give information.

In view of these facts, is it not probable that the time has come when the various societies working in the same municipal fields should at least cooperate to the extent of avoiding a duplication of each other's work, and should also hold their conventions at the same time and place, with joint sessions for the discussion of such questions as are of common interest? Here, for example, is the American Society of Municipal Improvements sending out inquiries as to garbage disposal, when only a few years ago the American Public Health Association did the same thing far more exhaustively. Here also is the former society considering city charters, municipal home rule and uniform accounting, while the National Municipal League, only three weeks later, and in the same city, will take up the same subjects, to say nothing of its very important earlier work along these lines. We are glad to note that the American Society of Municipal Improvements has just voted to request the National Municipal League to hold its convention next year at the same place and date as the former body; that the society accepted the invitation of the National Brick Manufacturers' Association to appoint a conference committee on brick pavements; and that the society established a promising new committee to co-operate with similar ones from other societies in a grand effort to further uniform accounts and reports and the collection of national municipal statistics. Surely a society which at one convention takes three such important steps as this bids fair to forge ahead in the future. We hope this will be only the beginning of its co-operation with other societies, and that eventually we may see a half dozen or a dozen of the municipal societies already in existence following the same plans, with an occasional, if not a yearly, conference of the various societies.

Why not an American Association for the Advancement of Municipal Government and Improvements, as well as an American Association for the Advancement of Science? The various national municipal societies could thus maintain their independent existence, although holding their annual conventions at the same time and place. The facts are that we are simply overburdened with society meetings and society papers. The meetings often conflict in dates and in any event are so widely separated in location as to make attendance on even a selected two or three quite an item of expense for traveling, to say nothing of time lost from work. Many of the papers and committee reports traverse the same grounds, often being practically if not actually identical and again being sufficiently diverse to require the reading of two or three very similar papers to make sure one has gained all the available information on a given subject. In addition to all this, municipal officers are beset on every hand for information on the same subject, and refuse or neglect to answer some or all the questions asked because of their constant repetition, whereas if they were assured that one response would suffice for a time they would be glad to give full reports.

The American Society of Municipal Improvements and the National Municipal League are organizations which in membership and aims are well fitted to lead in this much needed reform. The society has given and is giving the fullest consideration to the various branches of municipal public works, and has devoted much attention to questions of municipal policy; its membership is rich in practical experience in the lines indicated. The league has done and is doing noble work for municipal reform and the improvement of municipal conditions generally; it, too, has a membership rich in experience in the work in hand. The two bodies are working for a common end, the highest ideals in city life with the lowest possible expenditure of the taxpayers' money; the substitution of intelligence, interest and honesty for ignorance, indifference and corruption. There is no reason why these two societies may not co-operate to secure their common end through joint action and by enlisting other organizations in the movement.

If the society and the league meet together next year, they will have an excellent opportunity to consider what steps may best be taken by the various societies to secure uniform municipal accounting and what to bring about similar co-operation in other lines. A joint session might well be devoted to these subjects, or perhaps a session to each of them.

More discussion of papers and reports might have taken place at Milwaukee if the program had not been so crowded. The proceedings were often under pressure, so as to get all the papers read, and this was so apparent as to make the members reluctant to take part in the discussions. Much valuable time was lost by going over the same ground several times in different papers, and in a virtual repetition of matter presented in detail in former years. This was particularly true of the papers on paving and on sewage purification. Of course, some repetition from year to year is unavoidable and some is even desirable, in view of the changes in membership.

The changes in the constitution, broadening the scope of the membership, seem wise. The original plan was to make the membership primarily by cities and to limit the active membership to engineers or officials holding municipal offices. As time went on, many of the ablest individual members were virtually excluded from the society by the accidents of politics, while engineers not holding official positions were excluded from the start. Under the amendments, these limitations are removed, while in addition contractors and dealers in city supplies may become associate members, lacking only the right to vote or to hold office. These changes should result in a large increase both in membership and efficiency. If exhibits on the part of associate members are invited, as in the various water-works associations, a valuable new feature may result, as well as additions to the funds in the treasury.

LETTERS TO THE EDITOR.

An Invitation to Engineers to Become Members of the American Economic Association.

Sir: It is desired during the present year to largely increase the membership of the American Economic Association, and to attract to it a large number of intelligent business and professional men who are interested in the work of economic investigation. It has seemed to us that our work should appeal especially to the members of the engineering profession, who are brought in touch with economic questions in so many different ways. The Association already has the names of a number of engineers on its membership roll, but it desires to see this representation largely increased, and I take this means of bringing the matter to the attention of your readers.

The present membership of the Association is about 700. Practically all the teachers of economics in American universities are its members, and there are also many prominent editors, lawyers and business men. The Association is the organ of no party, sect or institution, and it has no creed. Persons of all shades of economic opinion are found among its members, and widely different views are given a hearing in its annual meetings and through its publications. Its income is spent almost altogether for printing. It has no salaried officers and no burdensome expenses.

Its aim and purpose is both to promote co-operation in economic studies and investigations, and to disseminate sound ideas on economic subjects and a more scientific method of dealing with economic questions.

The Association holds an annual meeting at which papers on subjects in its especial field are read and discussed, and special committees present reports on questions of public importance. The annual dues of the Association are only $3, and this sum entitles a member to receive the quarterly publication, conducted by a committee of the Association. Applications for membership should be addressed to the Secretary, Prof. Chas. H. Hull, Cornell University, Ithaca, N. Y. Very truly yours,

Richard T. Ely, President.

University of Wisconsin, Madison, Wis., Aug. 24, 1900.

Comparative Cost of Filtration at Albany and Lawrence.

Sir: In your issue of Aug. 30 is a communication from Mr. James H. Harlow with the above heading, in which the writer states that he has compiled a comparative statement of the operating cost of filtration by the two plans, which compilation gives the cost at Lawrence as $0.87 per million gallons, and at Albany $1.94 for a like unit.

A comparison had been made by myself which showed decidedly different, as follows: The cost per million gallons at Lawrence $8.19, and at Albany $1.97, the cost at Lawrence being more than four times as much as at Albany, instead of Albany's cost being more than twice as much as at Lawrence. So great a difference in comparison makes it evident that some one has blundered, and I submit herewith the data used by myself, that for Lawrence being taken from page 42 of the "24th Annual Report of the Lawrence Water Board for the Year 1899," and that for Albany being taken from Engineering News, issue of August 9, 1900:

	Lawrence. Gallons filtered 1169.8 million.		Albany. Gallons filtered 3817.2 million.	
	Cost.	Per million.	Cost.	Per mill'n.
Ice cutting and snow	$2,241.61	$1.91	.....	....
Scraping	.....	....	$948.97	$0.25
Sanding and scraping	3,716.55	3.18	.....	....
Wheeling out	.....	....	1,905.83	0.50
Washing sand	1,459.15	1.25	2,067.48	0.59
Conveying sand	1,530.55	1.31	.....	....
Refilling	.....	....	1,499.24	0.39
Incidentals	500.79	0.43	761.47	0.20
Repair'g elevator & tools	128.32	0.11	.....	....
Cleaning basin	.....	....	209.76	0.06
Total	$9,576.97	$8.19	$7,392.75	$1.99

On account of the difference in keeping records I wrote Mr. M. F. Collins, Foreman of the Lawrence Filter Plant, who informed me as follows:

Washing Sand. Includes only labor of four men at washing machine, and the cost of pumping wash water used.

Sanding and scraping. Sanding includes carrying of washed sand from washing machine and replacing it on the filter beds. Scraping includes scraping beds, and wheeling the scraped material from off the beds to a roadway.

Conveying sand means carrying the scraped material from roadway, where it is left after scraping, to the washing machine, a distance of about 470 ft.

Quantity Filtered. All the water filtered flows into a well, and is then pumped directly by both the high and low service pumps.

Wages. The pay for labor is 25 cts. per hour.

Assuming that the low service was the only one that pumped filtered water direct, as Mr. Harlow has done, the average cost per million gallons at Lawrence would be $8.69. Mr. Harlow's compilation gives the cost as 87 cts. Mr. Harlow in his letter says: "I presume there may be some explanation for these differences." Can it be that the explanation is that he has made an error in placing his decimal point, and compared 1/10 of the cost at Lawrence with the full cost at Albany? Yours truly,

Geo. I. Bailey.

Albany, N. Y., Aug. 31, 1900.

(A copy of the above letter was submitted to Mr. Harlow, and he writes us under date of Sept. 4:

Like the coon, I will "come down." I find that I misplaced the decimal point in my calculations as Mr. Bailey surmises, and his comparison is therefore correct. One reason why I was tempted to write my letter to you was the fact that I was surprised at the comparative cost, as I had been under the impression that the Albany filter would be very much the cheaper to operate.

The comparison in its present form is certainly very creditable to those responsible for the design and maintenance of the Albany filters. The cost of operation (practically $2 per million gallons filtered) is a figure which engineers may find it worth while to remember.—Ed.)

Flow of Water Through Clean and Through Dirty Pipes.

Sir: In his discussion, in the August number of the "Proceedings of the Am. Soc. C. E.," of a paper on the "Flow of Water in a 6-ft. Water Main," Mr. Desmond FitzGerald has rendered an excellent service to the practical hydraulician by directing attention to the necessity of considering the discharge through dirty rather than clean pipes. There can be no doubt that in the vast majority of cases, pipe lines become more or less obstructed by tuberculations or deposits of impurities as time goes on, and in consequence give progressively diminished deliveries.

I have shown elsewhere* that Darcy's formula for "rough" cast-iron pipes of from 8-in. to 48-in. diameter, reduces to:

$$\frac{Q^2}{h\ D^5} = 1. \qquad (1)$$

And for those of 3-in. to 6-in. diameter to:

$$\frac{Q^2}{h\ D^5} = 0.785. \qquad (2)$$

For similar "smooth" pipes, from 8-in. to 48-in. diameter:

$$\frac{Q^2}{h\ D^5} = 2. \qquad (3)$$

And from 3-in. to 6-in.:

$$\frac{Q^2}{h\ D^5} = 1.57 \qquad (4)$$

In the above
Q = cubic feet per second;
D = diameter in feet;
h = drop of hydraulic grade line (commonly called "loss of head") per 1,000.

Also for rough diameters

From 8-in. to 48-in.: $V = 1.27 \sqrt{D\ h}$; From 3-in. to 6-in.: $V = 1.13 \sqrt{D\ h}$.

And for smooth pipes, respectively:

$V = 1.80 \sqrt{D\ h}$; $V = 1.60 \sqrt{D\ h}$.

In which V = velocity in feet per second.

These formulas show that the discharge, and consequently the velocity of flow through a smooth pipe line, are 1.40 times those through a rough one of the same diameter and fall, and reciprocally the discharge and velocity through a rough pipe line are 0.70 times those through a smooth one. Also, the diameter of a rough pipe line should be 1.15 times that of a smooth one to give equal discharge and velocity, the reciprocal being 0.87.

These figures bring out in bold relief the great change in the discharging capacity of a pipe line consequent upon passing from the maximum degree of smoothness to the maximum of roughness, designated in Darcy's nomenclature simply by "smooth" and "rough."

As far as I have been able to verify the fact by checking these formulas against the measured discharges of given pipe lines which have been recorded from time to time in your columns and elsewhere, they cover the relations between delivery, diameter and head of all long cast-iron pipes as ordinarily manufactured and laid at the present day. That is to say, excluding all abnormal cases, and assuming good materials and workmanship, the capacity of the cleanest pipe line, will not exceed that given by (3) or (4), and that of the oldest and most deteriorated (barring extensive leakage and other exceptional conditions) will not fall below that given by (1) or (2).

I believe that the only safe course to pursue in estimating in advance the delivery of a projected pipe line of given diameter and fall per 1,000 ft., is to calculate it both as that of a smooth and rough pipe, assuming that when new and clean it will approach the higher limit, but with a constant and progressive tendency to reach the lower one.

Formulas (1) to (4) differ only in the numerical member. Calling this C, we have the general formula:

$$\frac{Q^2}{h\ D^5} = C.$$

This is the fundamental formula of the flow of water through long cast-iron pipes. It is the only one necessary for the hydraulic engineer to carry impressed upon his memory for it solves directly or indirectly all problems relating to the above subject, provided they are solvable, by substituting the proper value of C, taken from (1) to (4). Since all pipes tend to become obstructed, as Mr. FitzGerald has forcibly shown in the discussion referred to, we may broadly state that formulas (1) and (2) constitute the safe key to all problems of the class under consideration. In intricate problems considerable dexterity may be necessary to frame and a great deal of patience to solve the equation giving a direct solution; for instance, in the case of the aggregate discharge of a system of branch pipes. There always remains in such cases the resource of "trial and error," using the above formulas as a test, and the expert calculator by a judicious preliminary assumption of data will frequently reach a solution with great rapidity in this way.

E. Sherman Gould.

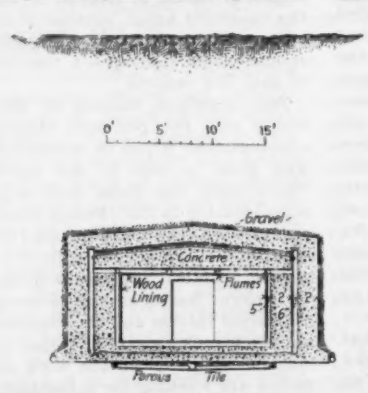
Yonkers, N. Y., Aug. 27, 1900.

*"The Elements of Water Supply Engineering," Engineering News Publishing Co.

THE CONSTRUCTION OF MOISTURE-PROOF UNDERGROUND CHAMBERS.

By L. R. Grabill, C. E.*

The increasing use of sub-surface construction renders of interest the subject of making waterproof such parts of it as are necessary to be so. In order to make an underground room moisture proof it is necessary: First, to remove by drainage as much as is practicable of the water in the ground surrounding the structure; second, to prevent percolation of water from the surrounding earth through the walls, roof and floor of the chamber; and third, to prevent the condensation of moisture upon the interior.



PLAN AND SECTIONS OF AN UNDERGROUND DYNAMO ROOM OF MOISTURE-PROOF CONSTRUCTION.

The removal of the ground-water may be provided for by means of spaces filled with gravel or broken stone which convey the seepage to suitably placed lines of porous drain tile, so laid that the water received is conveyed either to an outlet system or to a sump from which the water is removed by pumping.

Percolation through the masonry is best prevented by the application on all sides of the chamber, and above and below it, of one or more coatings of refined asphalt applied either to the exterior of the masonry or laid through it in a dampproof course. Tarred felt is used for the same purpose where it can be fastened. Walls to which asphalt is to be applied should have a fairly regular surface, but should not be so smooth as to prevent its adhesion.

Where concrete surfaces are exposed to the air, it is also found advantageous to apply a wash composed of alum and concentrated lye dissolved in water; and also to apply to exposed upper surfaces a coat of linseed oil and Portland cement, or of the hot oil alone; after having filled all cracks which exist with roofers' putty, or with a thick solution of asphalt in naphtha.

Condensation is the most difficult of the causes of moisture to prevent by ordinary means. It occurs mostly in warm weather, on account of the fact that the temperature of an underground chamber is then much lower than that of the atmosphere at the surface. The air outside is then also apt to be more heavily charged with moisture. Transfer of moisture from the damp outer air to the inside air, by absorption, defeats such ventilation of the condensation as might be accomplished by shutting off circulation as far as possible. Heating alone will accomplish little, for unless the air is changed the moisture is re-deposited when the temperature again falls. In the absence of free circulation the moisture tends to accumulate as it is condensed and leaves the air free to take up more from the outside atmosphere.

The best methods of preventing condensation are, first, to establish a circulation which will maintain a current of such volume that the temperature of the surrounding walls will be raised by contact with the incoming air; second, to so arrange the walls that their temperature will be lowered as little as possible by contact with the surrounding earth; third, the inner lining of the chambers should be a non-conductor of heat, and may be somewhat absorptive, like the paint of ground cork sometimes used.

An example is here given of an underground structure for the reception of an electric generator and similar machinery. This example is selected from among a number of somewhat similar constructions, but as involving on the whole the greater difficulties in the exclusion of moisture.

The depth of the floor of the chamber below the surface was about 30 ft., and the thickness of earth above the chamber was about 18 ft. The ground excavated was very wet and springy, consisting of clay and marl. Water in considerable quantity was encountered during excavation. The pit was made about 2 ft. wider on each side than was required for the walls, and was heavily timbered, as few cross braces as possible being used. The structure was of concrete. The walls were double, each part being 2 ft. in thickness. (It would have been better if the total thickness had been unequally divided, leaving the inner wall only 12 ins. thick.) A vertical 6-in. space between the two parts entirely surrounds the chamber, extending below the level of the floors and to a height of about two feet above the level of the ceiling.

*55 Quincy St., N. E., Washington, D. C.

Brick piers at the middle of each wall, built so as to permit circulation, were placed in the air space to combine the strength of the two walls. A drain of porous tile was laid around the footings of the structure, leading to an outlet at a lower level. The bottom of the vertical air space was formed into a gutter emptying into a catch-basin connecting with the drain tile. Above the tile and against the walls for their full height was placed a layer of washed gravel. A layer of the same material 6 ins. in thickness, intersected at intervals of 5 or 6 ft. with lines of porous tile, was placed under the concrete forming the floor of the chamber.

The wall of the vertical air space toward the chamber was covered with two coats of asphalt, making a total thickness of about ¼-in. This same course was extended, ½-in. thick, through the concrete in the roof, so as to entirely cover the ceiling of the chamber at a height of 2 ft. above it. The gutter at the bottom of the air space was covered with the same layer. A similar course, ½-in. thick, was placed in the concrete of the floor at about 6 ins. below the surface, being connected with the course in the gutters. The chamber was thus completely enveloped with a course of asphalt.

The asphalt above the ceiling was laid upon a carefully graded, nearly smooth surface of Portland cement mortar, and was given an inclination from the center toward the air spaces, into which it extended over eaves formed of brick, with the corners trimmed. Upon this was laid porous partition tile 2 ins. thick, and about 3 ins. of washed gravel was spread upon this before placing the other concrete upon it.

A coating of coal tar and pitch boiled together was applied to the outside of the exterior wall and over the top of the finished concrete. This course was merely precautionary, but it would have been better if formed of asphalt, as the coal tar in similar situations is found to deteriorate so as to soon become valueless. Outside of this coating another layer of gravel was placed.

The asphalt used was the refined Bermudez asphalt sold by the Barber Asphalt Paving Co., which contains a small amount of petroleum residuum. The first coat applied to the vertical walls consisted of this material dissolved in naphtha to the consistency of a thick paint, in the proportion of about 50 lbs. of asphalt to 10 gallons of naphtha. Of this, one gallon will cover 80 sq. ft. of concrete surface. This adheres readily and forms a basis for the application of the second coat, which consists of the asphalt heated and applied with brooms, making the asphalt adhere to vertical walls, if not long subjected to the heat of the sun.

In the layers which were horizontal, or nearly so, the naphtha solution was not used, but the asphalt was poured on hot, spread with brooms, and smoothed and rubbed with hot irons; the first coat being about ⅛-in. thick, upon which was placed a second about ⅜-in. thick. Both coats were rubbed until free of bubbles. It is necessary, of course, that the application be made to dry surfaces. This method of covering has been used in many other cases with great success in the results afforded.

The ventilation was accomplished by inserting in the concrete hollow tiles which extended through the inner wall, near the ceiling, to the air space. These tiles were 4 ins. square in area of section inside. They were placed at intervals of about 3 ft. At one end of the chamber, opposite the entrance, the vertical air space was connected with a flue built of concrete, and extending to the surface, of an area of cross section about equal to that of all of the tiles through the wall of the chamber. In addition, four bent flues of 8-in. cast-iron pipe were equally spaced about the ceiling of the chamber and carried to the surface. A strong circulation was thus provided for, the inlet being through the entrance gallery. It would be an improvement to have all air admitted to such places first pass through a drying chamber containing sufficient chloride of calcium, or some similar absorbent, to dry it thoroughly. By keeping the entrance closed and providing a separate conduit for the inflow of dry air, such chambers could be made perfectly free from moisture.

Fig. 1.—The "Yale" Submarine Arc Lamp. Manufactured by The Naval Electric Co., 95 Liberty St., New York city.

Where the air space was intersected by the entrance gallery, openings were left which could be left oper or closed at will. The circulation of warm air on both sides of the interior wall was thus provided for, the object being to raise the temperature of the wall so as to prevent condensation.

Inside of the concrete walls there was placed a wooden lining of dressed, tongued and grooved Georgia pine. This was set at a distance of 5 ins. from the concrete walls and ceilings, so as to have an air space of that width behind it. After the completion of the concrete work the earth cover was replaced.

Although the structure has been completed for several months, no dampness from any cause has been observed. The accompanying drawings explain themselves, and are intended to show the special features rather than any details of construction.

A SUBMARINE ARC LAMP.

The advantage of furnishing divers with artificial light is evident to any one. Nearly always they are compelled to work with only the sense of touch to guide them, and this makes their work slow and expensive. Attempts have been made to use the incandescent electric lamp in submarine work, but, as it is impracticable to make a lamp of more than 100 c. p., sufficient intensity cannot be obtained with a single lamp. Clusters of lamps are unwieldy.

Many attempts have been made to adapt the arc lamp to submarine use. In a series of experiments carried on at the Brooklyn Navy Yard, it was sought to furnish a supply of oxygen to the arc by means of rubber tubing reaching to the surface. This proved to be a cumbersome and troublesome device. It has been found that a small supply of oxygen is absolutely necessary in an enclosed arc lamp. Otherwise the particles of carbon projected from the electrodes will soon blacken the inner surface of the lamp globe.

The lamp herewith illustrated, Fig. 1, is an enclosed arc lamp of improved construction, protected by a water-tight casing. The supply of oxygen within the casing is sufficient to allow the lamp to be used continuously for 10 or 12 hrs., at the end of which time the carbons will also have to be renewed. One of the problems in the design of the lamp has been to so proportion the parts that the heat generated will be rapidly removed by the surrounding water. The lamp is of 2,000 nominal c. p.

The complete equipment of lamp, cables, rheostat and containing chest is shown in Fig. 2. One end of the deck cable is plugged into a jack connected to the ship's lighting circuit, and the double-conductor flexible submarine cable is attached to the other end. The submarine cable also serves to support the lamp, as may be seen from Fig. 1. The rheostat has capacity sufficient to allow using the outfit on any voltage from 80 to 125 volts. The lamp is about 18 ins. in length.

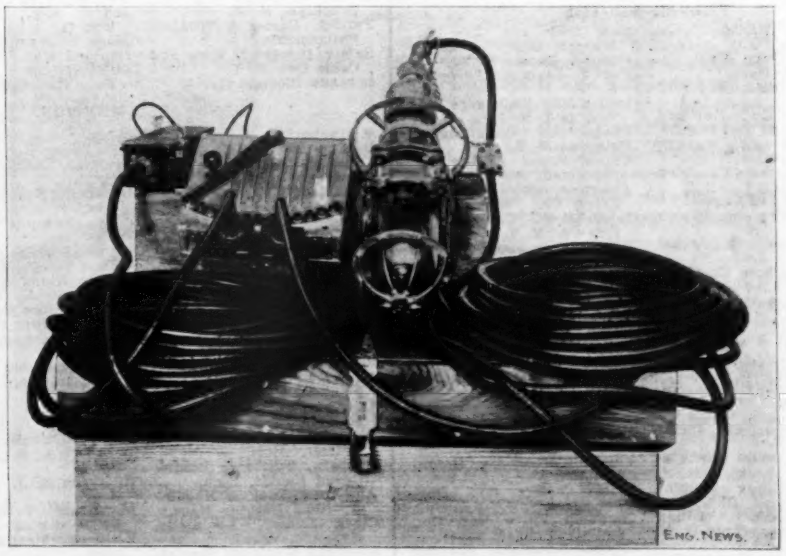


FIG. 2.—COMPLETE OUTFIT USED WITH SUBMARINE ARC LAMP.

The information from which this description has been prepared has been furnished to us by the Naval Electric Co., of 95 Liberty St., New York city, the manufacturers of the lamp.

PARIS EXPOSITION AWARDS IN THE DEPARTMENTS OF MECHANICAL AND MINING ENGINEERING.

We published in our issue of Aug. 23, a partial list of the awards to engineering exhibitors at Paris. A complete list of the awards in Groups IV. and V., Machinery and Electricity, and in Group XI., Mining and Metallurgy, is given in the Paris edition of the New York Times of Aug. 18, and in the American edition of the same journal of Sept. 2. We reprint this in full as follows:

Department of Machinery and Electricity.—Groups IV. and V.

Francis E. Drake, Director.

HORS CONCOURS.

Adams-Bagnall Co., Cleveland, Ohio.
General Electric Co., Schenectady, N. Y.
Hecla Iron Works, Brooklyn, N. Y.
Malcolmson (Chas.T.), Chicago, Ill.
Kearney & Foot, New York.
Standard Tool Co., Cleveland, Ohio.

GRAND PRIZES.

American Steel & Wire Co., Worcester, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Worthington Pumping Engine Co., N. Y.
Batcheller Pneumatic Tube Co., N. Y.
Otis Elevator Co., N. Y.
Browne & Sharpe Mfg. Co., Providence, R. I.
The Pratt & Whitney Co., Hartford, Conn.
Bliss (E. W.) Co., Brooklyn, N. Y.
Niles Tool Works Co., Hamilton, Ohio.
J. A. Fay & Egan Co., Cincinnati, Ohio.
Rowland Telegraphic Co., Baltimore, Md.
Western Electric Co., Chicago, Ill.
John A. Roebling's Sons Co., Trenton, N. J.
Acheson, (E. C.) Niagara Falls, N. Y.

GOLD MEDALS.

Simonds Mfg. Co., Fitchburg, Mass.
Chicago Pneumatic Tool Co., Chicago, Ill.
Morse Twist Drill & Machine Co., New Bedford.
Cincinnati Milling Machine Co., Cincinnati, O.
Hendey Machine Co., Torrington, Conn.
Warner & Swasey, Cleveland, Ohio.
Norton Emery Wheel Co., Worcester, Mass.
Bement-Miles Co., Philadelphia, Pa.
Atkins (E. C.) & Co., Indianapolis, Ind.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
Reed (F. E.) Co., Worcester, Mass.
Deering Harvester Co., Chicago, Ill.
Bullard Machine Tool Co., Bridgeport, Conn.
Pond Machine Tool Co., Plainfield, N. J.
Alvin Mfg. Co., N. Y.
National Carbon Co., Cleveland, Ohio.
Tiffany Glass and Decorating Co., N. Y.
Toerring (C. J.) Co., Philadelphia, Pa.
Leonard (Ward) & Co., Bronxville, N. Y.
Helios-Upton Co., Peabody, Mass.
Holophane Glass Co., N. Y.
Hart & Hegeman Mfg. Co., Hartford, Conn.
Mica Insulator Co., N. Y.
Bullock Electric Mfg. Co., Cincinnati, Ohio.
Lorain (O.) Steel Co.
Western Electric Co., Chicago, Ill.
Olsen (Tinius) & Co., Philadelphia, Pa.
Rand Drill Co., N. Y.
Schieren (Charles A.) & Co., Brooklyn, N. Y.
Crane Co., Chicago, Ill.
Ingersoll-Sergeant Drill Co., N. Y.
Shaw Electric Crane Co., Muskegon, Mich.
Ball Engine Co., Erie, Pa.
William Sellers Co., Philadelphia, Pa.
George F. Blake Mfg. Co., N. Y.
Edison Phonograph Works, Orange, N. J.
Weston Electrical Instrument Co., Newark, N. J.

SILVER MEDALS.

Ferracute Machine Co., Bridgeton, N. J.
Cleveland Twist Drill Co., Cleveland, Ohio.
Healy, (William P.,) Chicago, Ill.
Rice Gear Co., Hartford, Conn.
Landis Tool Co., Waynesborough, Pa.
Prentice Brothers Co., Worcester, Mass.
Q. & C. Co., Chicago, Ill.
Walworth Mfg. Co., Boston, Mass.
Starret (L. S.) Co., Athol, Mass.
Morgan Machine Co., Rochester, N. Y.
Gleason Tool Co., Rochester, N. Y.
Flather & Co., Nashua, N. H.
Springfield Machine Tool Co., Springfield, Ohio.
Clough (Rockwell) Co., Alton, N. H.
Baker Brothers, Toledo, O.
Acme Machinery Co., Cleveland, Ohio.
Horton (E.) & Son Co., Windsor Locks, Conn.
Ingersoll Milling Machine Co., Rockford, Ill.
Becker-Brainerd Milling Machine Co., Hyde Park, Mass.
Fellows Gear Shaper Co., Springfield, Ohio.
Gould & Eberhardt, Newark, N. J.
Curtis & Curtis, Bridgeport, Conn.
Smith (H. B.) Machine Co., Smithville, N. J.
Doig (W. S.), Brooklyn, N. Y.
Flather Planer Co., Nashua, N. H.
Becker (John), Fitchburg, Mass.
Bristol Co., Waterbury, Conn.
New York and Ohio Co., Warren, Ohio.
Oxley & Enos, N. Y.
Pass & Seymour, Syracuse, N. Y.
Iron Clad Resistance Co., Westfield, N. J.
Phelps Mfg. Co., Chicago.
Dale Co., N. Y.
United States Carbon Co., Cleveland, Ohio.
American Wireless Telegraph Co., Milwaukee.
International Cable Directory Co., N. Y.
Herzog Teleseme Co., N. Y.
Ritter Dental Mfg. Co., Rochester, N. Y.
American Steel Pulley Co., N. Y.
Tyler (W. S.) & Co., Cleveland, Ohio.
Robins Conveying Belt Co., N. Y.
Lunkenheimer Co., Cincinnati, Ohio.
Monarch Governor and Machine Co., Indianapolis.
Rice Gear Co., Hartford, Conn.
Thomson Meter Co., Brooklyn.
Walworth Mfg. Co., Boston, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Crocker-Wheeler Electric Co., Ampere, N. J.
Jeffrey Mfg. Co., Columbus, Ohio.
Eureka Tempered Copper Co., North East, Pa.
Shaw Electric Crane Co., Muskegon, Mich.
Wheeler Condenser and Engineering Co., N. Y.
Lunkenheimer Co., Cincinnati, Ohio.
Clonbrock Steam Boiler Co., Brooklyn.
Crane Co., Chicago, Ill.
Lee Injector Mfg. Co., Detroit, Mich.
Ashton Valve Co., Boston, Mass.
Walworth Mfg. Co., Boston, Mass.
Schaffer & Budenberg, N.Y.
Meitz & Weiss, N. Y.
H. Morgan Smith Co., York, Pa.
Rider-Ericsson Engine Co., N. Y.

BRONZE MEDALS.

Bickford Drill and Tool Co., Cincinnati, Ohio.
Cincinnati Planer Co., Cincinnati, Ohio.
Standard Pneumatic Tool Co., Chicago, Ill.
Quint (A. D.), Hartford, Conn.
Le Blond (R. K.) Machine Tool Co., Cincinnati, O.
Dock (Herman), Philadelphia, Pa.
Crane Co., Chicago, Ill.
Safety Emery Wheel Co., Springfield, Ohio.
Morton Mfg. Co., Muskegon, Mich.
Geometric Drill Co., New Haven, Conn.
Potter & Johnson Co., Providence, R. I.
Barnes (W. F. & John) Co., Rockford, Ill.
Builders' Iron Foundry, Providence R. I.
Wescott Chuck Co., Oneida, N. Y.
Waterbury Tool Co., Waterbury, Conn.
Grant Machine Tool Works, Cleveland, Ohio.
Gorton (George) Machine Co., Racine, Wis.
Goodall, Pratt Co., Greenfield, Mass.
Oster Mfg. Co., Cleveland, Ohio.
Hoggson-Pettis Mfg. Co., New Haven, Conn.
American Tool & Machinery Co., Boston, Mass.
American Machinery Co., Grand Rapids, Mich.
Pearson Machine Co., Chicago, Ill.
Springfield Mfg. Co., Providence, R. I.
Whitman & Barnes, Chicago, Ill.
Bradford Mill Co., Cincinnati, Ohio.
American Turret Lathe Works, Wilmington, Del.
Trimont Co., Boston, Mass.
Oneida National Chuck Co., Oneida, N. Y.
Fosdick & Holloway Machine Tool Co., Cincinnati.
Prentiss Vise Co., N. Y.
Hart Mfg. Co., Cleveland, Ohio.
Pratt Chuck Co., Frankfort, N. Y.
Vitrified Wheel Co., Westfield, Mass.
Armstrong Brothers Tool Co., Chicago, Ill.
American Electric Telephone Co., Chicago, Ill.
Dick Tool Co., Downers Grove, Ill.
Farr Telephone & Supply Co., Chicago, Ill.
Foot, Pierson & Co., N. Y.
Huebel & Manger Mfg. Co., Brooklyn, N. Y.
Patrick, Carter & Wilkins, Philadelphia.
Safety Insulated Wire and Cable Co., N. Y.
Sprague Electric Co., N. Y.
Standard Telephone and Electric Co., Madison, Wis.
Stromberg, Carlson Telephone Co., Chicago.
Telephone Mfg. Co., Sumter, S. C.
Western Telephone Construction Co., Chicago.
Vulcanized Fibre Co., Wilmington, Del.
Anderson (Albert & J. M.) Boston, Mass.
Belknap Motor Co., Portland, Me.
C. and C. Electric Co., Garwood, N. J.
Jenney Electric Mfg. Co., Indianapolis, Ind.
Milwaukee Electric Co., Milwaukee, Wis.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Electric Co., Cincinnati, Ohio.
Thresher Electric Co., Dayton, Ohio.
Lakon Transformer Co., Elkhart, Ind.
Pittsburg Transformer Co., Pittsburg, Pa.
Thomas (R.), & Sons Co., East Liverpool, Ohio.
New York and Ohio Co., Warren, Ohio.
Standard Paint Co., N. Y.
Almond (T. R.), Brooklyn, N. Y.
Chase-Shawmut Co., Boston, Mass.
Frink (I. P.), N. Y.
Chicago Fuse and Wire Co., Chicago.
Incandescent Electric Light Manipulator Co., Boston.
Inglis (William) Wire and Iron Works, Detroit.
McLeod, Wood & Co., N.Y.
Meyrowitz (E. B.), N. Y.
American Electric Novelty Co., N. Y.
Forbes & Co., Newark, N. J.
American Steam Gauge Co., Boston, Mass.
Ambler Asbestos Air Cell Covering Co., N. Y.
Keystone Engineering & Mfg. Co., Philadelphia.
Mosher (Charles D.), N. Y.
Taunton Locomotive Mfg. Co., Taunton, Mass.
Pelton Water Wheel Co., San Francisco, Cal.
Marshall (William), N. Y.
Wagner Electric Mfg. Co., St. Louis, Mo.
American Electrical Heating Corporation, Cambridgeport, Mass.
Sempire Clock Co., St. Louis, Mo.
Fisher Governor Co., Marshalltown, Iowa.
Ludlow Valve Mfg. Co., N. Y.
Ashton Valve Co., Boston.
Jeffrey Mfg. Co., Columbus, O.
Hugo Bilgram, Philadelphia.
Neptune Meter Co., N. Y.
Stillwell-Bierce & Smith-Vaile Co., Dayton, Ohio.

HONORABLE MENTION.

Errington (F. A.), N. Y.
Perkins Machine Co., South Boston, Mass.
Oesterlein Machine Co., Cincinnati, Ohio.
D'Armour & Littledale, N. Y.
Slocomb (J. T.) & Co., Providence, R. I.
Almond (T. R.), Brooklyn, N. Y.
Ransom (Perry), Oshkosh, Wis.
Nicholson (W. H.) & Co., Wilkesbarre, Pa.
Walker (O. S.) & Co., Worcester, Mass.
Eames (G. T.) & Co., Kalamazoo, Mich.
Universal Machine Co., Providence, R. I.
Leland Faulconer Mfg. Co., Detroit, Mich.
Baldwin, Tuttle & Bolton, Grand Rapids, Mich.
American Tool & Machinery Co., Boston, Mass.
Clark (James), Louisville, Ky.
American Electrical Specialty Co., N. Y.
Eldridge Electric Mfg. Co., Springfield, Mass.
Gold Car Heating Co., N. Y.
American Electric Heater Co., Detroit, Mich.
Gordon Battery Co., N. Y.
Hadaway Electric Heating and Engineering Co., N.Y.
McKay Engineering Co., Baltimore, Md.
Abbot Electric & Mfg. Co., Cleveland, Ohio.
Garten-Daniels Co., Keokuk, Iowa.
Wagner Electric Mfg. Co., St. Louis, Mo.
Circular Loom Co., Boston, Mass.
General Equipment Co., Camden, N. J.
Chase-Shawmut Co., Boston, Mass.
Crown Woven Wire Brush Co., Salem, Mass.
Crouse Hinds Electric Co., Syracuse, N. Y.
Holmes Fibre Graphite Co., Germantown, Pa.
Ingersoll-Sergeant Drill Co., N. Y.
A. T. Henderers Sons, Wilmington, Del.
Bristol Co., Waterbury, Conn.
Christensen Engineering Co., Milwaukee, Wis.
Dresser (S. R.), Bradford, Pa.
Anderson (H.), Peekskill, N. Y.
Insulating Saddle Staple Co., Brockton, Mass.
Klein (Mathias) & Son, Chicago.
Pennsylvania Electric Co., Marietta, Pa.
Viaduct Mfg. Co., Baltimore, Md.
Direct Separator Co., Syracuse, N. Y.
De Rycke (Joseph), N. Y.
Sherwood Mfg. Co., Buffalo.
McDonland (G. T.), Brooklyn, N. Y.
United States Metallic Packing Co., Philadelphia.
Johns (H. W.) Mfg. Co., N. Y.
Fiske Brothers Refining Co., N Y.

Mining and Metallurgy.—Group XI.

F. J. V. Skiff, Director.

GRAND PRIZES.

American Steel & Wire Co., New York.
California State Commission to the Paris Exposition, San Francisco, Cal.
Colorado Fuel & Iron Co. of Pueblo, Denver, Col.
Copper Queen Consolidated Mining Co., New York.
United States Geological Survey, Wash., D. C.
Ingersoll - Sergeant Drill Co., N. Y.
Oil Well Supply Co., N. Y.
American Museum of Natural History, N. Y.
Lehigh Valley Coal Co., Wilkesbarre, Pa.
Robins Conveying Belt Co., N. Y.
American Tin Plate Co., N. Y.
Crescent Steel Co., Pittsburg, Pa.
John A. Roebling Sons Co., Trenton, N
Fayette R. Plumb, Frankford, Philadelphia
The Hibbard-Rod[illegible] Ely Safe Co., N. Y.
The Eagle Lock Co[illegible]rryville, Conn.
Yale and Towne M[illegible] Co., N. Y.
American Steel & [illegible] Co., Reading, Pa.
Winslow Brothers [illegible] Chicago.
Simonds Mfg. Co., [illegible]chburg, Mass.
J. H. Williams Co., [illegible]klyn.
E. C. Atkins & Co., [illegible]anapolis, Ind.
Bommer Brothers, [illegible]klyn, N. Y.
The Stanley Works [illegible]w Britain, Conn.

GOLD MEDALS.

American Institute of Mining Engineers, N. Y.
Barney Marble Co., Swanton, Vt.
Bullock Mfg. Co., Chicago.
California State Mining Bureau, San Francisco.
Drake & Co., St. Paul, Minn.
Jeffrey Mfg. Co., Columbus, Ohio.
Geo. F. Kunz, New York.
New Almaden Quick Silver Mining Co., New Almaden, Cal.
New York State Museum, Albany.
North Carolina State Board of Agriculture, Raleigh, N. C.
North Carolina State Commission to the Paris Exposition, Raleigh, N. C.
Pike Mfg. Co., Pike Station, N. H.
Rand Drill Co., N. Y.
Richard P. Rothwell, N. Y.
Charles Kirchoff, N. Y.
Frank E. Saward, N. Y.
M. H. Fuller, Massachusetts Institute of Technology, Boston.
Iron Age Publishing Co., N. Y.
Weimann Seaver Engineering Co., Cleveland, O.
Colorado Smelting and Mining Co., Denver, Colo.

SILVER MEDALS.

Enterprise Mfg. Co., Philadelphia, Pa.
Hibbard, Spencer, Bartlett & Co., Chicago, Ill.
McCormick Harvester Machine Co., Chicago, Ill.
North Brothers Mfg. Co., Philadelphia, Pa.
Stover Mfg. Co., Freeport, Ill.
Griswold Mfg. Co., Erie, Pa.
Atha & Illingworth Co., Newark, N. J.
De La Mar Mining Co., Mercur, Utah.
Ligonier Fire Brick Co.
Illinois Steel Co., Chicago, Ill.
Rogers, Brown & Co., 71 Broadway, N. Y.
Franklin (H. H.) Mfg. Co., Syracuse, N. Y.
Charles F. Binnes, Trenton, N. J.
Colorado College, Colorado Springs, Colo.
Cornell University, Ithaca, N. Y.
Field Columbian Museum, Chicago.
Foote Mineral Co., Philadelphia.
Geological Survey, Trenton, N. J.
Independence Mining Co., Colo.
Portland Mining Co., Cripple Creek, Colo.
Henry P. Lowe, Idaho Springs, Colo.
Massachusetts Institute of Technology, Boston, Mass.
Maxwell Land Grant Co., Raton, N. Mex.
Michigan School of Mines, Houghton, Mich.
Mollie Gibson Consolidated Mining Co., Aspen, Colo.
National Bank of Commerce, Seattle, Wash.
New Jersey Zinc Co., Franklin Furnace, N. J.
New Sapphire Syndicate, Great Falls, Mont.
North Carolina State Museum, Raleigh, N. C.
Pacific Coast Borax Co., San Francisco, Cal.
John Pierce, Denver, Colo.
Princeton (N.J.) University.
University of Chicago, Chicago, Ill.
Woods Investment Co., Colorado Springs, Colo.
Wood, T. S., Leadville, Colo.
American Turquoise Co., N. Mex.
Calaveras Consolidated Mining Co., Cave City, Cal.
California State Mining Bureau, San Francisco, Cal.

BRONZE MEDALS.

Assyrian Gilsonite Co., Salt Lake City, Utah.
Central Phosphate Co., Beaufort, S. C.
Colorado Scientific Society, Denver, Col.
Columbia Marble Quarrying Co., Tuolumne Co., Cal.
W. B. Dwight, Vassar College, Poughkeepsie, N. Y.
Geological Survey, Indiana, Indianapolis, Ind.
Geological Survey, Kansas, Lawrence, Kan.
Geological Survey, Kentucky, Lexington, Ky.
Geological Survey, Michigan, Lansing, Mich.
Kesseler Brothers, San Francisco, Cal.
Nathan F. Leopold, 102 Dearborn Street, Chicago.
Watts & Heikes, Boulder, Col.
Poulot & Voilleque, Denver, Col.
Prof. F. C. Carrera, Las Cruces, N. Mex.
Oneida Community, Niagara Falls, N. Y.
Standard Caster and Wheel Co., N. Y.
Shelton & Co., Shelton, Conn.
Franklin (H. H.) Mfg. Co., Syracuse, N. Y.
American Tin Plate Co., Chicago and New York.
Carnegie Steel Co., Pittsburg, Pa.

HONORABLE MENTION.

A. Blanc, Kern Co., Cal.
J. H. Winslow, Riddles, Ore.
Wyoming University, Laramie, Wyoming.
A. Davidson.
Alfred H. Smith & Co., Raleigh, N. C.
Mme. Zeitler.
Kinney Talc Co.
J. E. Tallmadge.

GRAPHITE PAINT AS A SCALE PREVENTATIVE FOR THE HEATING SURFACES OF STEAM BOILERS.

The use of graphite to prevent the formation of scale on boiler tubes, etc., is a new idea which has recently been tested experimentally with results that are reported to us as being very satisfactory. In the autumn of 1892, the Detroit Graphite Mfg. Co., of Detroit, Mich., had occasion to repair one of its boilers, 60 ins. diameter and 16 ft. long, taking out all the tubes and lengthening them, as

they were leaking at the ends. Some of them were badly pitted, but they were all thoroughly cleaned, and some of them were brushed over very carefully with a thin coat of No. 48 graphite paint, which was allowed to dry thoroughly before the tubes were placed in the boiler. The head and some portions of the inside of the shell were also painted. It was nearly six months before the boiler was again opened, and no scale was found on any of the flues or on any part of the boiler. This boiler has been in continuous use since, carrying 90 lbs. of steam. It is inspected periodically by both the agent of the Hartford Insurance Co. and by the city inspector, and has been pronounced every time free from scale and in excellent condition. The last inspection was by the Hartford Insurance Co.'s inspector on June 3, 1900, whose report says: "Internally, shell plates and tubes are practically free from scale."

It has been necessary to wash the boiler out frequently, because the sediment, which would ordinarily form scale, drops off from the tubes and falls to the bottom, and unless it is washed out, it would burn on there and cause trouble. The small quantity of paint applied nearly eight years ago has not only saved a great deal of trouble in the cleaning of the boiler, but has saved a large amount of coal, since a clean boiler, of course, steams more easily than one that is encrusted with scale. Since this first experience others have tried the same material on boiler tubes, and it has been found that its success depends as much upon its application as upon the paint itself. It must be brushed onto the iron very carefully, spread out in a thin coat that will cover all parts, and allowed to thoroughly dry for three or four weeks before water is let into the boiler. It has been tried in the boilers of the Price Hill Inclined Plane, at Cincinnati, O., and has also been used by the Toledo, St. Louis & Kansas City Ry. The Price Hill Inclined Plane R. R. Co. states that in the autumn of 1898 two new tubular boilers, 4 ft. 6 ins. diameter, and 16 ft. long, were put in, and had the shells and tubes painted with one coat of the graphite paint, which had a month to dry before the boilers were used. It took three gallons to do the work. No chain or scraper has been used on these boilers, and they are clean and free from scale. This company also paints the inside of all of the feed water pipes, and finds it lengthens their life considerably. Mr. R. E. McDuffie, President and General Manager of this company, states that it has saved in fuel at least ten times the cost of the treatment, to say nothing of the improved condition of the boilers.

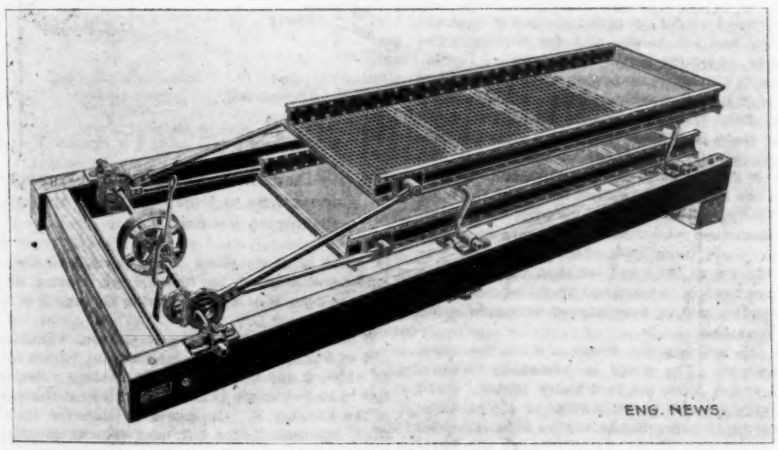


FIG. 1.—A BALANCED RECIPROCATING SCREEN.

BOOK REVIEWS.

ELECTRIC MOTIVE POWER.—The Transmission and Distribution of Electric Power by Continuous and Alternate Currents. With a section on the applications of electricity to mining work. By Albion T. Snell, Assoc. M. I. C. E., M. I. E. E. New York: D. Van Nostrand Co. Cloth; 6 × 9 ins.; pp. 410; 224 illustrations; tables. $4.00.

This book is largely devoted to English practice in electrical power engineering, but, perhaps, from that very fact, it will be found valuable, and, especially, suggestive to the American engineer. In one respect if is very characteristically English; it is addressed primarily to the consulting engineer, and it is assumed that in working on a power transmission problem he will be called upon to design the entire outfit from dynamo to motor. Therefore the book takes up the details of design of all kinds of electrical machinery and apparatus used in the electric transmission of power as well as the broader and more general engineering questions involved. On this side we are more inclined to accept the finished standard apparatus of the manufacturer as our materials of construction and to devote our attention mainly to making such choice and arrangement of these materials as will give the best results. The outcomes in the respective cases are that the English engineer manages to get his ideas and whims embodied in his plant, while we get our machinery more cheaply, and it is designed by specialists, and so, in the majority of cases, is probably better.

All treatment of the elementary theory of electricity and magnetism is omitted, and formulas are given without derivation. The author prefers to use the inch-pound-minute system of units. It is hard to see why this complication should be introduced, since the electrical units are founded on the centimeter-gram-second system. It would be much less confusing to base all formulas upon and perform all operations with the latter system and then, if the English system of units must be used by the workmen, translate the final results.

The contents are arranged in ten chapters, each of which is a monograph on some portion of the subject. The last two chapters deal exhaustively with the applications of electricity to mining work, particular attention being paid to coal mining. The titles of the chapters are as follows: The General Plan of Electrical Transmission of Power; The Dynamo and Motor; The Line and the Distributing Mains; Direct-Current Systems of Transmitting and Distributing Electrical Power; Single-Phase Alternators and Alternate-Current Motors; Transformers; Single-Phase Alternate Current Transmission and Distribution; Polyphase Alternate-Current Working; Electric Transmission of Power in Mining Operations; Coal Cutting and Rock Drilling by Electric Power.

A BALANCED SHAKING SCREEN.

We illustrate herewith a new shaking screen built by the Aultman Co., of Canton, O. The peculiar feature of the machine is that the two screens, upper and lower, are so balanced, one against the other, as to counterbalance and destroy the destructive shock or vibration common to screens of the usual design. As shown in the drawing, each of the screens is supported by four rocker arms, which are pivoted respectively on the upper and lower sides of the timber framing. Motion is given to each of the screens by connecting rods driven from eccentrics on a countershaft. The eccentrics driving the two screens are set opposite each other on the shaft, so that when one is pulling the other is pushing, and vice versa. The thrust or shock of all reciprocating parts is thus balanced at the countershaft, so that none is transmitted to the foundation or structure on which the machine is placed.

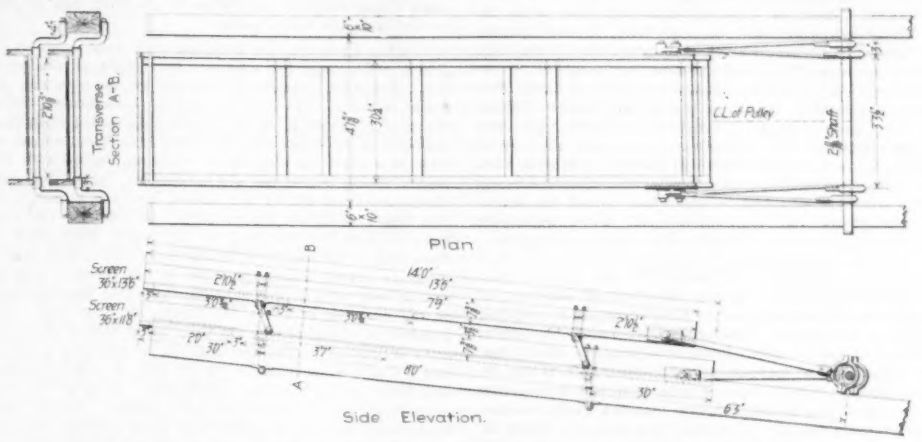


FIG. 2.—BALANCED SCREEN FOR THE BEATTY FIRE CLAY CO., MAGNOLIA, O.
The Aultman Co., Canton, O., Manufacturers.

Fig. 1 is a perspective view, illustrating the general design of the machine, and Fig. 2 shows working drawings of a screen recently furnished to the Beatty Fire Clay Co., of Magnolia, O. The screen as shown has a capacity of 15 to 20 tons per hour with favorable dry materials, such as sand, phosphate, coal or cement, and about two-thirds as much where the materials are damp. The wire cloth or perforated metal is carried in removable wooden frames, which facilitates the work of cleaning or of changing the size of separation.

The machine is also built with four screens instead of two where required, and the manufacturers offers to make tests and submit the results on any material requiring separation.

THE CANADIAN EXCURSION OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.

The unqualified success of the excursion of the American Institute of Mining Engineers to the Pacific Coast in 1899, prompted it, upon the cordial invitation of its Canadian members and friends, to hold its summer meeting this year in Canada, in connection with an extensive excursion trip to the principal mining and metallurgical centers of Nova Scotia and Newfoundland. Altogether from the time the special excursion train left New York city until its return on Aug. 31, the meetings and excursions occupied two weeks. During that time the members visited in Quebec province the mining machinery manufactures at Sherbrooke, the asbestos mines at Thetford and the city of Quebec. In Nova Scotia the principal points of interest were the coal mines and new steel plant which are being opened up by Mr. Henry M. Whitney, of Boston, Mass., at Sydney, the Nova Scotia Steel Co.'s works and the Intercolonial Coal Co.'s mines at New Glasgow, and the Waverly Gold Mines at Halifax. Some of the party also visited the iron mines of Newfoundland, and the Nova Scotia journey was enlivened by trips to Louisburg, Pictou, Bras d'Or Lakes, Halifax and other points of historical and scenic interest.

Living on board a train, as the members did continuously for a fortnight, has its trying features under the most favorable circumstances and this occasion was no exception to the general rule; but after the column of petty annoyances had been cast up and the balance drawn there was to the credit of the account an overwhelming opinion that the party had spent a most profitable and enjoyable two weeks among excellent hosts and in a country whose promise of future development in mining industry is a substantial one

Preliminary Excursion from New York.

The assembling point for the excursion party was the Chateau Frontenac in the city of Quebec, the special train being scheduled to leave that city on the evening of Aug. 19, and the members being left to their own choice of time and route for reaching the meeting place. Most of the western members of the Institute and the Canadian party, therefore, begun their trip as a part of the excursion party at Quebec. The New York members and those from the eastern states convenient to New York, however, made arrangements to proceed together from New York city, leaving on Aug. 17 in two Pullman cars attached to the regular 4.15 p. m. train to Quebec via the New York, New Haven & Hartford, Boston & Maine, and Quebec Central railways, and arriving at Sherbrooke, Quebec, the first stopping point of the excursion, on the early morning of Aug. 18. The weather, which was sweltering in New York city, became refreshingly cool during the night; and many of the members who had for the nonce joined the much-ridiculed brigade of "shirt waist men," found waistcoats and light wraps none too warm in the early morning air.

Sherbrooke, Quebec.

The New York party, numbering about 60 persons, including the ladies, were met at Sherbrooke by a reception committee of citizens, headed by Mr. James F. Lewis, President of the Canadian Rand Drill Co., and after a few minutes spent in making introductions, was taken by special electric cars to the Hotel Magog, where breakfast was served and a formal welcome extended to the visitors by representatives of the Mayor, City Council, Board of Trade and Citizens' Committee. From the hotel the party proceeded upon an interesting round of visits to the carpet and woolen mills, the Jenckes Machine Co., and other industrial plants, which finally terminated at the works of the Canadian Rand Drill Co., where luncheon was served. The industrial prominence of Sherbrooke among the eastern Canadian cities is due very largely to the excellent water power provided by the falls of the Magog River. This stream, which furnishes an outlet for Lake Memphermagog into the St. Francis River, has a fall of about 170 ft. in three-quarters of a mile, and is estimated to have an available water power of 4,500 HP., of which about 3,000 HP. are now utilized by the various industrial concerns along its banks. It should be noted, however, that the Jenckes Machine Co. and Canadian Rand Drill Co., the two most important establishments of the town in the mechanical line, do not use the water power, principally because of lack of space and railway accommodations within a practicable distance of the falls.

Jenckes Machine Co. and Canadian Rand Drill Co.'s Works.

The shops of the Jenckes Machine Co. employ about 250 men and turn out a considerable proportion of the mining machinery used in Canada. The main building is 300 × 150 ft., and has a good equipment of tools for hoisting engine, saw and pulp mill, and general mining and mill machinery work. This building is provided with a 20-ton electric overhead traveling crane, covering by its movement a space of 300 × 40 ft. The Canadian Rand Drill Co. formerly occupied a portion of the shops of the Jenckes Machine Co., but the growing business compelled it in 1899 to build separate works, which are located on the line of the Canadian Pacific Ry., on the outskirts of the town, and are particularly notable for the extensive use which is made of compressed air. Mr. S. W. Jenckes and Mr. J. M. Jenckes, of the Jenckes Machine Co., became respectively Vice-President and Secretary of the new company, with Mr. James F. Lewis as President.

The new plant consists of a large main machine and erecting shop, pattern shop, storage shed and subsidiary buildings. The main building, 200 × 90 ft., is of brick with side wall 15 ft. high, with the monitor portion of the roof 35 ft. high. The roof trusses are of Georgia pine; the roofing is 3-in. plank covered with tin, and the flooring is 3-in. hemlock plank set on 8 × 8-in. timbers, filled between with broken stone pounded down and covered with concrete. This floor construction has proved to be so solid that all ordinary machinery needs simply to be fastened to it by lag screws, individual concrete foundations being required only for the larger machines. The window area in the side walls and in the monitor roof is very large and the whole interior of the building is covered with asbestic whitewash, making the shop an exceptionally light one. To one side of the main building are joined three wings, each 30 × 36 ft., one at each end and one at the middle, which serve respectively for a blacksmith shop, power house and offices. The wing containing the offices has a second story, which is utilized for the drawing rooms, blue print rooms, vaults, etc. To the rear of the center wing containing the power plant is a coal storage shed arranged for the separate storage of steam, tempering and blacksmith coal. Behind this coal storage shed is the pattern shop and to one end of the main shop is the pattern storage house, both buildings being similar in construction to the main building.

The arrangement of the machinery in the main shop is on two sides of a center aisle. The plan adopted was not to group similar tools together; but knowing exactly the work to be done upon the product, it was planned to place the tools so that the rough casting is passed from the machine performing the first operation to that performing the second and so on to the erecting floor for assembling. Air compressors and hoists are built on the left side and drills and coal cutters on the right side of the shop. The assembling floors are at the ends of the shop. The erecting floor for small compressors is covered by a 2-ton traveling crane. For the erection of large compressors the main aisle is employed so that the main traveling crane running lengthwise of the shop can be used for handling the heavy parts.

Roughly speaking, the main erecting floor occupies the center aisle space for one half the length of the building. The floor consists of I-beams set on cast-iron bed plates which in turn rest on concrete foundations. These beams are leveled up so that a machine placed upon them requires to be lined sideways only. At one end of the floor is a pit 4 ft. wide by 20 ft. long, walled with masonry, which serves as a fly-wheel pit when the large compressors are set up for testing previous to shipment. The heavy tools are placed along the sides of the main aisle so that the handling of the heavy work done on them may be accomplished by the large crane. The smaller tools are placed nearer the sides of the building and are run by two rows of line shafting extending longitudinally of the building at about the middle of each side. The transfer of power across the shop is by means of a rope drive at one end. The line shafting is mostly 2 7-16 ins. and 2 3-16 ins. in diameter, fitted with split steel pulleys and Hyatt roller bearings throughout. Most of the machine tools are of Canadian manufacture. In the drill department, where standardization is an absolute requirement of construction, the construction is all jig work, each individual part having its special jig. The tool room, which is necessary for keeping the jigs in order, is equipped with a lathe, twist-drill grinder, universal grinder and milling machine, and in addition emery wheels are placed at convenient intervals around the shop. At one end of the building is a supply room separated from the main shop by a wire fencing, and here are kept all finished duplicate drill parts, packing, pipe fittings, compressor and engine parts and attachments, etc.

At the same end of the building as the supply room is the blacksmith shop occupying one of the wings. This shop is equipped with two large and two small forges, and three tempering forges. Here also is placed the power hammer, which is operated by compressed air. The handling of heavy work is done by a radial crane arrangement consisting of an I-beam pivoted at the center, the ends of which travel on a circular track. A trolley travels along this I-beam and carries an air hoist. By means of the horizontal swing or revolution of the beam on its center pivot and of the travel of the carriage running along the beam it will be seen that the whole floor area of the shop is covered by the air hoist. The draft for the forges is obtained by a blower and the smoke is removed by an exhauster. In the middle wing opening off the main building is located the power plant, a fire wall separating the boilers from the rest of the plant. A 90-HP. Jenckes-Corliss engine operates the main line shafting, while a Rand standard duplex compressor with 8 × 14 × 12 ins. compound air and 8 × 12 × 12 ins. compound steam ends furnishes compressed air for operating the power hammer, traveling cranes and air hoists, and for testing drills, cleaning castings, operating piston drills, etc.

In some respects the most interesting of the compressed air machines is the large traveling bridge crane covering the main shop floor from one end to the other of the building. This crane is of 10 tons capacity and was built by the Whiting Foundry Equipment Co., of Harvey, Ill. It is employed for loading cars, erecting work and handling heavy work on the large machine tools bordering the main center aisle. The weight of any machine or of its individual parts is ascertained while loading the cars by means of a Fairbanks' scale hung from the crane hook. The hose carrying the air to the crane is taken care of by an arrangement overhead of a carriage traveling on an I-beam. The crane is said to have proved especially satisfactory in its operation.

For heating the building the Evans-Almiral hot-water system is employed. The water is heated by exhaust steam after it comes from the feed-water heater, which passes into a large exhaust heater similar to a feed-water heater. A centrifugal pump in the engine room provides the necessary circulation of the water through the heating coils which comprise some 1,500 ft. of 1½-in. pipe located around the sides and overhead on the cross beams of the building. This system has successfully heated the shop with the temperature at — 35° F. outside. The shop building is equipped with the Walworth sprinkler system, consisting of 450 sprinklers arranged to cover every part of the shop. The supply of water is furnished from two sources: one being the city water mains and the other a 500-gallon fire pump located in a separate pump house and taking its water from the Magog River. In addition there are four 2½-in. hose lines from the city water mains. The pattern shop has a similar sprinkler system to the main shop, but the pattern storage house and general storage house are equipped with dry sprinkler systems.

As already stated the party, after examining the company's new works, concluded their visit to Sherbrooke with a hearty luncheon which was spread in the new pattern shop, and, which, after the half day's tramping in the bracing air, proved a welcome diversion from the [illegible] round of sightseeing with which they had previously been entertained. Immediately after luncheon the party, augmented by a number of its Sherbrooke hosts, boarded its cars, which, through the courtesy of the management of the Quebec Central Ry., had been made up as a special train, and resumed the journey to Thetford, Quebec, where the programme of entertainment called for a visit to the famous asbestos mines of the Thetford District, to be followed by a dinner provided by the courtesy of the Asbestos Bros., Johnson's and Bell's asbestos companies, which operate at that point.

(Concluded in our next issue.)

A SIGNALING DEVICE FOR MINES.*

By C. S. Herzig.†

Some time ago, in Mexico, our signal-bells in a [illegible] shaft caused us considerable annoyance by continually getting out of order, each time so delaying our hoisting operations that we naturally desired to remedy this evil. There were two ways open; either to patch up the old bell, which was of the ordinary pattern, every time it failed to work, or else to devise some new arrangement. On consultation with our foreman we designed a signal-device which during the number of months that I watched its operation, worked satisfactorily, without once getting out of order.

We sought to produce a simple device in which no greater pull on the lever would be necessary from one level than from another; to counterbalance independently the weight of the pendant bell-rope, so that there would be no direct weight on the working parts of the bell itself, and likewise to arrange it so as to necessitate only a light pull on the lever in signaling; and finally to make some sort of trip-arrangement, so that whenever the signaling-lever underground passed through a certain arc the signal would be given in the engine-room. By this means we wished to obviate the ill effects of sudden heavy pulls and rough usage in general, such as all signaling systems encounter underground at the hands of careless or mischievous employees.

The bell-rope we had in use was a galvanized iron rope 7-32-in. in diameter; and, after determining the length needed, we calculated its weight, so that we might be able to counterbalance properly. On locating the bell in the engine-room a wire, W, is led off horizontally, and by means of a bell-crank is connected to the main signal-rope, M, passing down the shaft (Fig. 1). The weight W_2 counterbalances M, and should be heavy enough to carry the wires back to a normal position, therefore it must be equivalent to the weight of the pendant rope, M, plus an amount to overcome friction.

The working parts of the bell itself are shown in Fig. 2. A is a weighted lever, to the upper end of which the connecting wire W is attached, the arm, a, projecting from it

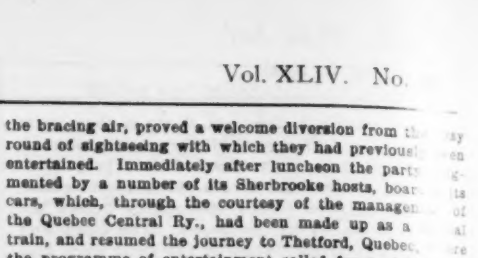


Fig. 1.—Diagram Showing General Arrangement and Connections of Mine Signal and Method of Counterbalancing Pendant Rope.

is made of steel, about 5 ins. long, and has a bearing surface of 1 in. at its further end, resting on a similar surface b on B. A cross-section through x y is shown in Fig. 3.

B is a piece of flat spring-steel about 8 ins. long, at the end of which is the bearing surface b. D serves as a hub, to which B and C are attached; C being a flat spring similar to B, but about 12 to 14 ins. long, at the end of which is the knocker E. It should be observed that B is vertical, whereas C lies flat, and that C should not be as heavy a spring as B.

When the bell-rope is pulled to signal the engineer, the wire W moves in the direction of the arrow, and the arm a traveling downward in a circular path around f as a center forces b to move downward around D as a center until the arcs in which they are traveling diverge far enough for gravity to carry B-C back again to its normal position, B being arrested by the stop; however, the force with which the arm flies back causes the knocker to strike the gong and thus give the signal. As soon as the bell-rope is released, the arm A is carried back to its original position, and in so doing the triangular surface on the end of a slides upon the inverted triangle b (II., Fig. 3), forcing it to one side (III., Fig. 3), until it rests in its normal position on top of b, when it is ready for another pull, as shown at I., Fig. 3.

*Read before the Canadian meeting of the Institute of Mining Engineers.

†Virginia, Minn.

counterbalancing the weight of the pendant bell-rope, sufficient weight must be added to the counterbalance to bring the levers underground back into position automatically. The counterweight may be located at any convenient place on the head frame, providing it is above the bell-rope to which W is attached.

In order to prevent the pull necessary for signaling from becoming excessive, it is desirable to reduce friction as much as possible. A force equivalent to a 10-lb. weight should be sufficient for pulling the levers in a well-arranged signaling system. To accomplish this, I think it advisable to bring a bell-rope into proper alinement by means of plumb-lines, and to hold the rope in position by short pieces of old iron pipe 2 to 3 ins. long, instead of by means of staples, as is so commonly done. In inclined shafts the bell-rope should be supported at frequent intervals on some form of roller. The spools on which connecting-wire comes make good rollers, in the absence of anything better.

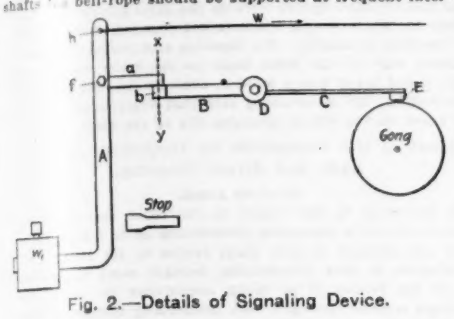


Fig. 2.—Details of Signaling Device.

That there may be no mistake, the arm C should be long enough, and the knocker E heavy enough to cause their instant return to position when the paths of a and b part company. For this purpose it is also advisable to put a stop below B, so that by no possible chance can it fly beyond its balance-point.

By increasing or diminishing the bearing of the triangles a and b, the arc traveled can be changed. In my opinion it is not advisable to increase this bearing above the inch mentioned before. The triangles, as shown in section, Fig. 3, should have bases of about ¾-in., with perpendiculars of ¾-in. to 1 in. The bearings of the two points f and d should be good ones, so that there will be no lateral motion, which might make a fail to engage properly with b. Any play of d or f is considerably magnified at the triangles; but by making the bases of these triangles large enough, the chances of their not working properly are greatly lessened. By moving the position of h with respect to the center f, the arc of pull underground, necessary to signal, can be regulated.

The spring B must be quite stiff and of good material; but it must be borne in mind that the stiffer the spring the

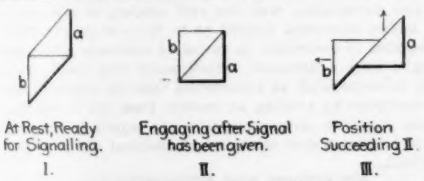


Fig. 3.—Sections Through x y (Fig. 2), Showing the Action of a and b.

heavier must be the weight w_1, and, in consequence, the greater the effort required to pull the levers; nevertheless, w_1 must be heavy enough to bring back the wire W and to overcome the resistance of the spring B. If the arm A is made sufficiently heavy, the use of a counterweight (w_2) may be dispensed with, although it is preferable to arrange as shown in Fig. 2, for by this means it can be properly adjusted. If w_1 is too heavy, the arm A has a tendency to pound against the stop s_2. While w_1 must not be too heavy, its weight must not be cut down to such an extent as to impair the instant return to position of the arm A.

The whole apparatus may be mounted on a board and located in some convenient place in the engine-room.

ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

The seventh annual convention of the American Society of Municipal Improvements was held at Milwaukee, Wis., Aug. 28 to 31. The attendance was fair in number and of good quality. In his presidential address, Mr. A. D. Thompson, of Peoria, Ill., spoke of the many defects in municipal government and said one of the objects of the society was to help correct those defects. He suggested the possibility of the formation of State branches of the society.

The report of the secretary, among other things, showed that during the year 27 copies of the last annual report of the society had been sold and 22 copies of earlier reports. The treasurer showed a balance on hand of $43.

Report of the Committee on Municipal Data.

C. C. Brown, Chairman.

For various reasons, the chairman was the only member of this committee during the past year. No new uniform schedules have been added to those for water-works, sewers and paving, previously presented, owing to the failure to secure additional members to the committee who should be experts in the fields to be covered. Mr. Brown called attention to the great need for uniform municipal accounts and reports, and reviewed briefly some of the attempts to that end, chiefly in their relation to the similar work of his committee. The ideal system of accounting and the ideal form of report would enable the citizen to trace the progress of the money he pays in taxes through all the departments of the city government until it finally disappears from the city treasury, and to form an estimate of the economy with which it is managed, by means of comparison with the results in other years and with those in other municipalities.

One reason why these ideals are not attained is the ignorance of those responsible for municipal accounting and another is the desire of dishonest officials to have their actions hidden.

Uniform reports are more easily secured than uniform methods of bookkeeping. In fact, the former can be made up, though with unnecessary labor, from well kept books, even if the latter are not uniform. Expert aid is essential to the preparation of schemes for uniform reports and full discussion of the proposed forms is desirable. Thus far the forms submitted by the committee have had scarcely any discussion from members of the society, except the general discussion at the meeting a year ago. The committee recommended a committee of conference to work with other societies interested in securing uniformity.

The water-works schedule formulated by this committee is not quite so elaborate as the tables relating to water-works in the report on municipal ownership, just issued by the U. S. Department of Labor, but is more elaborate than those adopted by the American and the New England Water-Works Association. Experience has shown that the schedules of these two associations are not sufficiently comprehensive.

Report of the Committee on Municipal Statistics.

August Herrmann, Chairman.

This committee was appointed a year ago to co-operate with a similar one from the American Society of Civil Engineers in securing the collection of national municipal statistics by the Twelfth Census. The efforts of the two committees have resulted in little thus far, the Census Bureau explaining (as pointed out in this journal over a year ago) that it could not touch municipal statistics until 1902. Another object of the committee was the securing of a permanent census bureau. As to the probabilities of such a course, a letter was read from Mr. S. Whinery, M. Am. Soc. C. E., chairman of the other committee, already mentioned, stating that there had been 30 years of agitation for a permanent census bureau, with no results, and suggesting that perhaps the work in question might be entrusted with more promise to the U. S. Department of Labor. Mr. Herrmann seemed to concur in this view. In conclusion, he recommended the appointment of a special committee to co-operate with other societies along the lines under consideration. This recommendation was adopted and both the committees which had just reported were continued. Later, it was voted to consolidate the two committees, under the name of the Committee on Uniform Municipal Reports and Accounting and National Municipal Statistics, the committee to consist of three members, appointed by the incoming president.

Uniform Accounting and National Municipal Statistics.

By M. N. Baker.

This paper was designed to show the relation between the two subjects included in its title and particularly to stimulate joint action for both uniform accounting and national municipal statistics by the various societies devoted to municipal affairs. Various phases of the same general subject were discussed in our issues of July 27, 1899, June 14 and July 5, 1900. Since we have devoted so much space to the subjects discussed in the paper in question, and inasmuch as the author is a member of the editorial staff of this journal, our report of the convention will pass over the paper by Mr. Baker with the brief reference already made, which will possess the double advantage of not risking repetition and of allowing more space for the other papers and discussions. The brief discussion on this paper brought out the statement that progress towards uniformity is being made in Canada through provincial supervision of municipal accounts. Mr. Robert E. McMath, M. Am. Soc. C. E., said that in the United States uniform municipal accounting must be secured through the action of the several States.

Cement Testing for Municipal Works.

By Horace Andrews, M. Am. Soc. C. E.

The gist of this paper was a suggestion that cities cooperate and maintain a joint laboratory near cement works to obviate some of the difficulties incident to small laboratories connected with overworked city engineering departments. The State Engineer and Surveyor of New York has recently offered to make cement tests for cities, but time could be saved by establishing laboratories nearer the cement plants. There was no discussion of the paper.

Report of the Committee on Street Paving.

Geo. W. Tillson, M. Am. Soc. C. E., Chairman.

The report proper of this committee was brief. After expressing surprise at the failure of cities to profit by the experience of other municipalities, the committee stated that it had tried to secure papers embodying standard practice in the construction of various kinds of pavements. It does not follow, as we understand it, that the committee endorsed the principles or practice set forth in the papers, several of the latter consisting chiefly of reviews of the practice in the cities with which the authors were officially connected. All the papers agreed on the necessity for good sub-drainage, thorough rolling of the sub-grade and a concrete foundation of at least 6 ins. depth. The other features of the papers may be summarized as follows:

Asphalt; by Geo. W. Tillson:—A 1-in. binder is sufficient. The wearing surface is made about 2 ins. in thickness. The sand used in the mixture may vary from the size that will pass a sieve with 10 meshes to 1 in. down to dust. The rollers used on the asphalt should be light at first, then heavier, to ensure vertical instead of lateral pressure. Where the asphalt extends to the curb a strip 1 ft. wide in each gutter should be plastered with asphalt cement and then have a hot iron applied. Asphalt pavements laid as described should wear ten years without much repairing and 18 to 20 years without resurfacing. Messrs. Thompson, Capellen and Rust believed the gutters should be paved with brick or some other material less affected by water than is asphalt. Messrs. Jones, Capellen and Benzenberg thought street watering had a bad effect on asphalt, and it was generally agreed that the patrol system of cleaning, supplemented by machines and by flushing should be utilized so as to reduce the sprinkling to a minimum.

Medina Stone Block; by E. A. Fisher:—This paper was devoted chiefly to practice in Rochester, N. Y., where the paving contractor is made responsible for all new underground work done at the time the pavement is being put down; the contractors for the latter, if separate, also being held responsible for settlement of trenches for three years. A cushion of some 2 ins. of clean, sharp, dry sand is used. The blocks are 3 to 5 ins. wide, 7 to 12 ins. long and 6 to 6½ ins. deep. They are laid in courses at right angles to the curbs, except at intersections, where an angle of 45° is employed. The joints are filled with hot gravel and paving pitch. The gravel will pass through a 4-mesh and be retained on an 80-mesh sieve. The pitch is No. 4 paving composition. On four streets laid this year an average of 1.38 gallons of pitch to 1 sq. yd. was used. The streets are given a crown of 5 ins. for a 30-ft. roadway, and a minimum grade of 4 ins. per 100 ft., where possible. In answer to some criticisms by members, Mr. Fisher stated that the only way to ensure proper backfilling of trenches is to make the paving contractor peculiarly responsible for settlements, it being understood that this does not apply to work done prior to the paving in question. City inspection forces are inadequate to secure proper backfilling by mere supervision.

Granite Block; by Josiah Briggs:—The standards here given were drawn from New York specifications. A 2-in. sand cushion is used. The blocks must be uniform in color and hardness. They measure 3½ to 4½ ins. in width, 8 to 12 ins. in length and 7 to 8 ins. in depth. They are laid at right angles to the curb, and herring-bone style at intersections. Gravel for the joints must pass a ⅝-in. mesh and be retained on a ⅜-in. mesh sieve. Asphalt is used as a filler, or oil and tar.

Brick; by E. A. Kemmler:—The practice at Columbus, O., was the basis of this paper. A 1-in. cushion of soft and velvety sand is preferred; that containing 12% of calcareous matter gives good results. The brick, after laying, are rammed and then rolled. No filler has been found that can be accepted as a standard. Sand is cheap, but does not prevent chipping. Asphalt and tar run. Cement is cheaper than asphalt or tar and should be given thorough trials before being abandoned. For the last three years all brick have been tested in accordance with the standard adopted by the National Brick Manufacturers' Association. The new standard of that association conforms more closely than the old, with the results shown after the brick are down and used.

Mr. Kemmler also made some pertinent remarks on the general failure of American cities to pay any attention, relatively speaking, to street maintenance.

After the reading of this paper a letter from T. A. Randall, Secretary of the National Brick Manufacturers' Association, was read, and, in accordance with its suggestion, provision was made for a conference committee on the construction of brick pavements.

The Value of Chemical Tests for Asphalt Mixtures.

By. W. H. Broadhurst.

The object of such tests is to give contractors latitude in the composition of such mixtures and at the same time retain a check on the results. A clause in the New York contracts provides that whatever the character of the asphalt may be, or the manner of manipulation and laying,

the pavement obtained shall be equal in consistency, surface and durability to the standard pavement described in the specifications. It shall contain no water nor appreciable amount of light oils or volatile matters at a temperature under 250° F. It shall yield, when extracted with bisulphide of carbon, and after evaporation of the solvent, not less than 9% nor more than 12% of pure bituminous matter. All of the mineral matter shall pass a 10-mesh per lin. in. sieve and not less than 15% shall pass a 100-mesh sieve, while the remainder shall be graduated between those limits.

Report of the Committee on Sewerage and Sanitation.

W. K. Eldridge, Chairman.

The report dealt chiefly with stream pollution and sewage purification. A few court decisions on stream pollution were reviewed and a statement was made that some of the decisions laid down conditions with which it was impracticable for cities to comply. The standard for effluents from purification works should vary with the destination of the effluent. Recent information from Havana, Cuba, shows that plans for a sewerage system have been made and that a large percentage of the streets have been macadamized since American occupation. The sewerage work has been done by S. M. Gray, M. Am. Soc. C. E., of Providence, and D. E. McComb, of Washington, D. C.

Notes on the Baltimore Sewerage Problem.

By Kenneth Allen, M. Am. Soc. C. E.

No progress towards a sanitary sewerage system has been made since the second report of the sewerage commission, renewing its recommendation for disposal by dilution. Meanwhile New Orleans and San Francisco are moving for sanitary sewers, leaving Baltimore quite alone among the great cities of America.

Sewage Purification.

By E. A. Herman.

A comprehensive general review of the subject was given by the author of this paper.

Sewage Disposal and Water Purification.

By John McClintock.

This paper, as was brought out in the discussion, described the system of sewage treatment being promoted by the American Sewage Disposal Co., of Boston, under patents granted to the late Amasa Glover. The author claimed, in the discussion, that a patent granted in 1882 covered the septic tank and that later patents cover the combination of the septic tank with one or more filter beds and also double filtration. These claims and allied subjects were discussed in our issue of Dec. 7, 1899. The author suggested that ultimately garbage might be treated in septic tanks. For water purification he proposed sedimentation in long tanks, thus securing the benefit of any septic action that may result; lateral straining through coke; and filtration through 5 ft. of sand.

Recent Progress in Sewage Purification in England.

By Gilbert J. Fowler.

Mr. Flower is chemist of the sewage disposal works at Manchester, Eng., and having been requested to send over a paper responded most admirably. He gave a clear and interesting review of recent English work, experimental and otherwise, including the extensive experiments at Manchester. The Local Government Board still adheres to the opinion of the Royal Commission of 1857 that sewage should be treated on land, but the heavy soils of England make quite impracticable the methods of intermittent filtration so exhaustively studied by the Massachusetts State Board of Health and so readily applicable in Massachusetts and wherever large areas of sandy land are available. The Manchester experiments have shown that for the sewage of that city preliminary settlement is advisable before filtration and that this, combined with other valuable work, can be accomplished in either open or closed septic tanks. The large volumes of manufacturing wastes at Manchester give no trouble, but it might be different with other towns, having trade wastes of a different character, such as grease or dye stuffs. Septic tanks, the author is inclined to think, should have a capacity equal to the sewage flow for one day. Open septic tanks give as good results as closed, but the roofs prevent the scum from being blown off and might be advantageous in preventing the spread of bad odors. The borough surveyor of Leicester has reported that a septic tank would be a nuisance and advised aerobic treatment. The experiments at Manchester and Leeds indicate that septic tanks need be cleaned but once a year, but more frequent cleaning might be necessary in other places. Where sewage contains iron salts much sludge accumulates in the tanks. Generally speaking, septic sewage may be purified by one filtration through contact beds, but raw sewage would require two. With care in the details of construction, beds 3 ft. deep should purify 600,000 U. S. gallons per day, according to the Manchester results. A business is being developed in the way of buying up waste clinkers and preparing them for filter beds.

In discussing this paper, Professor Talbot, who was in England this summer, said he was disappointed to find so many failures and partial successes in sewage treatment in England. Much of the English work has been unsystematic, but this cannot be said of the recent experiments. Air-tight septic tanks are not required in so temperate a climate as England, but the extremes of both heat and cold in America make covering more desirable, if not essential. At Sutton, the coarse contact beds have clogged and a septic tank is being put in. Probably the septic tank will prove superior to contact beds for anaerobic effects. Against the 10,000 to 100,000 gallons per acre possible under intermittent filtration, from 1,000,000 to 5,000,000 gallons a day are claimed for contact beds and (according to Mr. Fowler—Ed.) 3,000,000 to 8,000,000 gallons for the so-called continuous filters of Ducot, Whittaker and Stoddard. For the past two years, over 1,250,000 U. S. gallons of sewage per day has been treated at Accrington, England, by a septic tank and Whittaker continuous filter beds, the sewage being sprinkled over the latter by revolving, perforated arms.

Sanitary Plumbing in Public Schools.

By Chas. B. Ball, M. Am. Soc. C. E.

This important subject was admirably reviewed by the author. It is desirable to place water closets in wings. Individual water closets, if strong and durable, are preferable to latrines or troughs, presenting less fouling surface. Wash basins should be distributed through the building and porcelain is in many respects the most desirable material for basins, retaining a better surface than marble or enameled iron.

Report of Committee on City Government and Legislation.

Robert E. McMath, M. Am. Soc. C. E., Chairman.

The committee chose for consideration the topic, "Municipal Home Rule, its Scope and Limitations," and reviewed at some length the powers and duties of municipalities. It advocated the separation of state and municipal functions, in order to lessen state interference and also the influence of national and state politics in municipal affairs.

City Government.

By F. W. Capelien, M. Am. Soc. C. E.

This paper was an exhaustive review of a large number of city charters throughout the world, occupying some 180 typewritten pages. Only a few extracts were read, but the paper will be printed in the proceedings of the society. The recent model charter of the National Municipal League was included in the paper and highly commended by Mr. Capelien. A few modifications were suggested. With honest officials most any charter would do.

Report of the Committee on Review.

Geo. M. Ames, Chairman.

Improvements in various cities during the year were reviewed by the committee, many of which have been noted in previous issues of this journal. In response to 200 requests sent to city engineers and others for notes of interest only eight replies were received and many requests for annual reports brought in only 17 for review. Concrete sewers are being used at Cambridge, Mass. One city reported a saving of 68 cts. per catchbasin per year, by transferring their cleaning from the health to the drainage department. In Philadelphia, shade trees will be planted on both sides of Broad St. In St. Paul 3,977 trees had been planted on 14¾ miles of streets, to the close of 1898. The cost of a large number of these trees averaged $3 each. The trees are planted under a guarantee that they will live at least three years.

Report of the Committee on Park Development and Maintenance.

Prof. A. N. Talbot, M. Am. Soc. C. E., Chairman.

After passing over, without reading, some suggestions for the future, Professor Talbot made some comparisons between American and European parks, which, making allowances for differences in age, were on the whole quite favorable to this country. We are behind in the matter of small open spaces and playgrounds, art features and public comfort stations in the business sections. Commendation was given to the public baths and laundries of London. In the discussion of this paper, Mr. M. N. Baker called attention to the Metropolitan Park System of Boston and vicinity and the Essex County Park System of Newark and adjoining municipalities, as affording examples which might be followed with advantage elsewhere, particularly in securing desirable lands outside the largest cities or towns concerned. Mention was also made of the fact that there is an organization known as the American Park and Outdoor Association. Mr. Thompson stated that the laws of Illinois permit the organization of park districts and that one has been formed, including Peoria, its suburbs and some rural sections.

Tree Planting on Streets and Boulevards in Large Cities.

By E. C. Lydon.

Mr. Lydon, who is secretary of the Milwaukee Park Board, urged that some city department should have control over all trees planted in city streets, since few property owners know anything about the selection or planting of trees. He would plant no trees over 3 ins. in diameter, owing to the difficulty of rooting in the hard soil of streets and beneath pavements and sidewalks. Mr. Capelien stated that in Minneapolis all trees in streets are planted and maintained by the park department.

Report of the Committee on Electric Street Lighting.

By F. W. Capelien, M. Am. Soc. C. E., Chairman.

This report was an analysis of the electric light section of the recent report of the U. S. Department of Labor on Municipal and Private Ownership of Water, Gas and Electric Light Plants. An average of figures given in the report showed a rate of depreciation for some 900 plants of 5.6%, which agreed pretty well with the 6% suggested in Engineering News a while ago and the 7% used by the Massachusetts Gas & Electric Light Commission. Of 141,000 arc lamps reported, 10,500 are of the enclosed type.

Mr. Baker stated that it was a happy accident that the average rate of depreciation mentioned agreed with any other figures, since the depreciation for each plant was on estimate or guess, ranging from zero to 15%. He believed the electric light figures were on the same general basis as those for water-works, which it had required about a week of his time to master. Mr. Capelien said the electric light figures were on the same basis as the water-works, and that it had taken him a week to abstract the data given in his report. Mr. Benzenberg said that depreciation should be based on the life or probable life of the plant.

Report of the Committee on Disposition of Garbage and Street Cleaning.

By John Jones.

A statement in this report to the effect that inquiries sent to 44 cities requesting information as to actual practice had resulted in only eight replies to the letters, all declinging to give information, brought some discussion as to the failure of so many committees to secure responses to their circulars. Mr. Benzenberg thought it was because so many of officials addressed had retired from office, or the letters were merely sent to the mayor or city engineer, instead of being made personal. Mr. Ashley said inquiries should be formulated so as to be easy of answer, by yes and no, so far as possible, and not crowded. Mr. Baker thought the duplication of inquiries on the same subject by different societies was responsible for the neglect of many of them and cited this as an example of the need of co-operation between societies working in the same fields. This very subject of garbage disposal, for instance, was thoroughly canvassed only a few years ago by a committee of the American Public Health Association, of which Mr. Rudolf Hering, M. Am. Soc. C. E., was chairman. The different societies devoted to municipal affairs might hold joint meetings, or at least meet at the same time and place. It is a pity, for instance, that this meeting should be followed in three weeks by that of the National Municipal League, in the some city, instead of the two being held together. A motion by Mr. Capelien was then adopted, instructing the secretary to request the National Municipal League to meet at Niagara Falls next year, on the same date as the American Society of Municipal Improvements.

Water-Works Improvements.

By G. Bouscaren, M. Am. Soc. C. E.

Water purification was the real subject of this paper. The author expressed himself as in favor of nearby filtered supplies in preference to so-called naturally pure water brought from a distance. Sterilization and ozone treatment, he considered, as refinements thus far impracticable. He concluded by reading an extract from the recent Cincinnati report on improvements to the supply of that city, in which extract slow sand and mechanical filtration were described.

Excursions and Entertainment.

One evening and three afternoons were devoted to drives and rides, including visits to some of the public works and buildings of the city and also to the works of the Milwaukee Cement Co. and of the E. P. Allis Co. At the cement works a face blast was witnessed which dislodged rock for a length of 185 ft. and a depth of some 20 ft., said to be sufficient to make 25,000 bbls. of cement. At the Allis works, among other interesting things, there was seen one of the 5,500-HP. engines for the new Glasgow electric railway, being made ready for shipment to Scotland.

General Business.

The constitution was amended so as to make eligible to full membership those not holding official positions under city governments and also so as to admit contractors and others as associate members. As to qualification for membership the constitution now reads:

Any municipality within America shall be eligible to membership in this society; likewise any engineer, officer or director who shall have charge of or supervision over or be employed as consulting engineer on any public or municipal department work. When a municipality has become a member of the society then any person of such municipality representing any municipal board or department or any person of good standing who may be interested therein may also become a member, who is not a contractor or contracting agent. Any member who may be a member, but shall have ceased to hold a position under a municipality, may retain his full membership, unless it becomes restricted under the rules. Contractors, contracting agents or dealers may become members of the society, but shall not have the privilege of voting or holding office.

Officers were elected as follows: President, Robert E. McMath, M. Am. Soc. C. E., of St. Louis, Mo.; Secretary, D. L. Fulton, Allegheny, Pa.; Treasurer, F. J. O'Brien, Oswego, N. Y.; the last two were re-elected. Niagara Falls was chosen as the place of the next meeting.

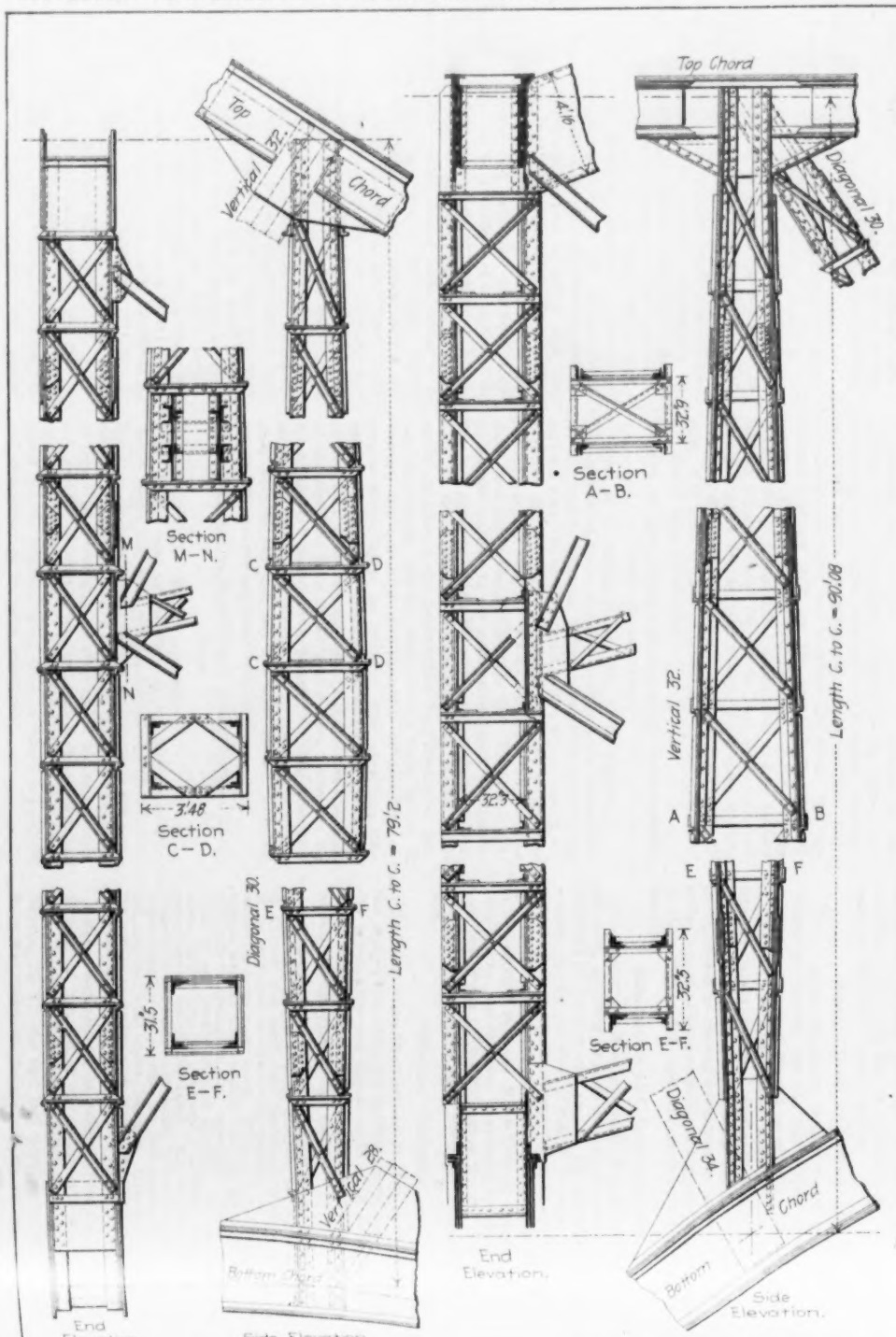


FIG. 7. DETAILS OF MAIN

FIG. 8. DETAILS OF MAIN

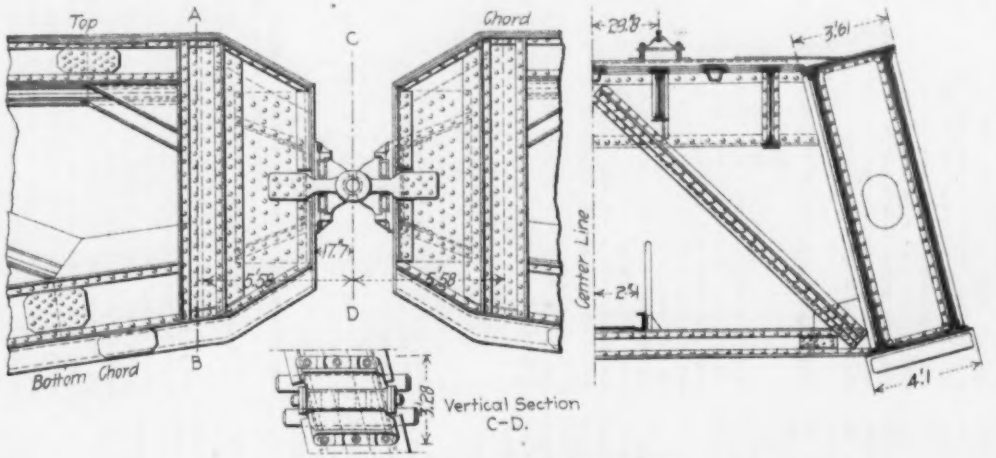


FIG. 16. DETAILS OF CENTER HINGE.

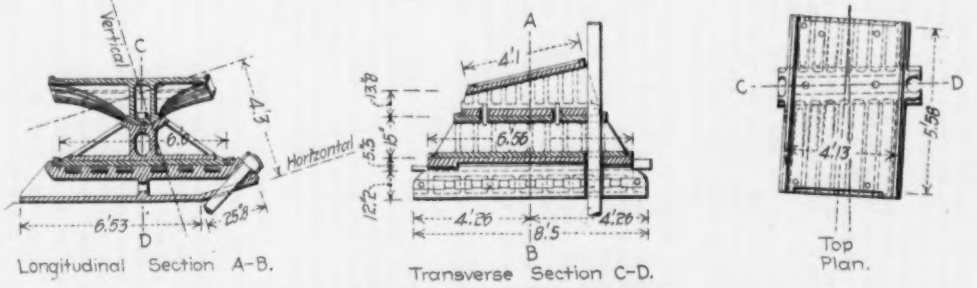


FIG. 15. DETAILS OF SKEWBACK HINGES.

FIG. 5. DETAILS OF TOP CHORD CONSTRUCTION.

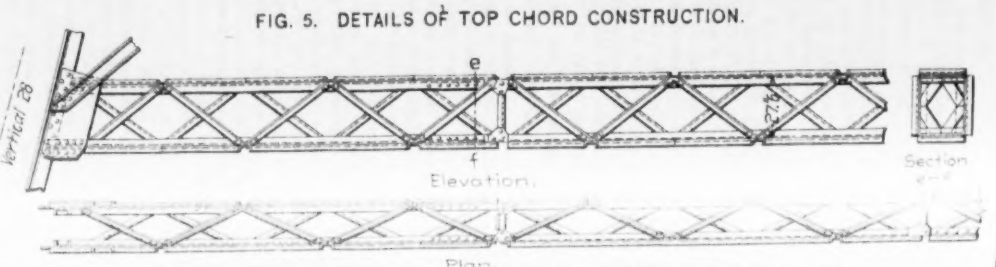
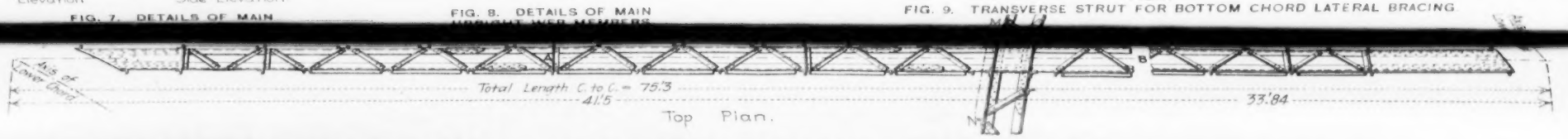


FIG. 9. TRANSVERSE STRUT FOR BOTTOM CHORD LATERAL BRACING

FIG. 7. DETAILS OF MAIN

FIG. 8. DETAILS OF MAIN

FIG. 9. TRANSVERSE STRUT FOR BOTTOM CHORD LATERAL BRACING



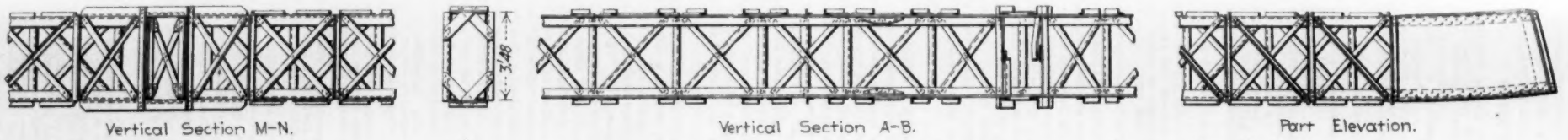


FIG. 10. DIAGONAL FOR BOTTOM CHORD LATERAL BRACING.

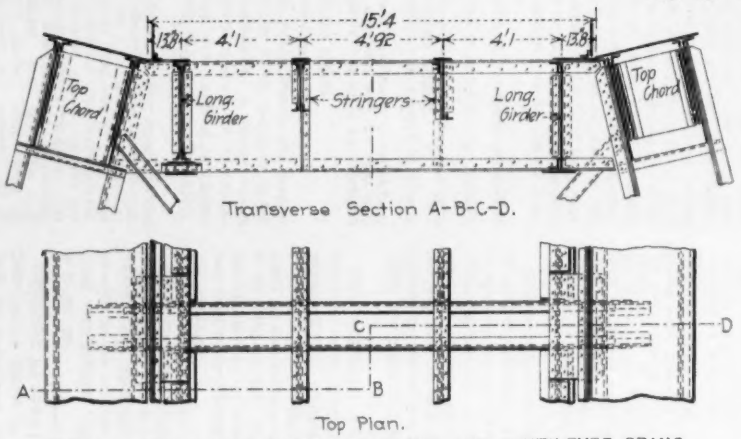


FIG. 11. BOX FLOOR GIRDER FOR MAIN AND CANTILEVER SPANS.

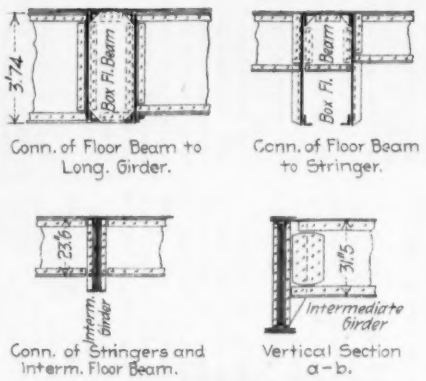


FIG. 13. DETAILS OF CONNECTIONS FOR FLOOR SYSTEM.

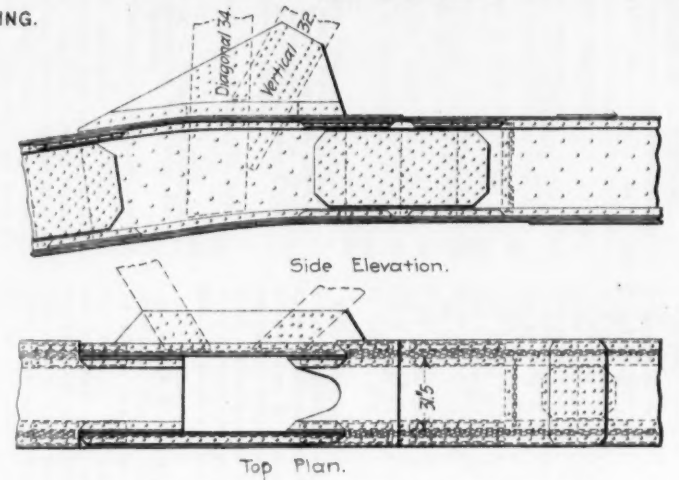


FIG. 6. DETAILS OF BOTTOM CHORD CONSTRUCTION.

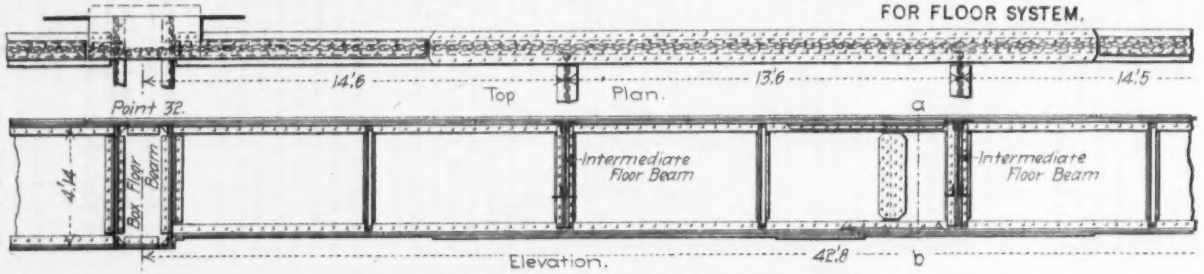


FIG. 12. LONGITUDINAL GIRDER FOR FLOOR SYSTEM.

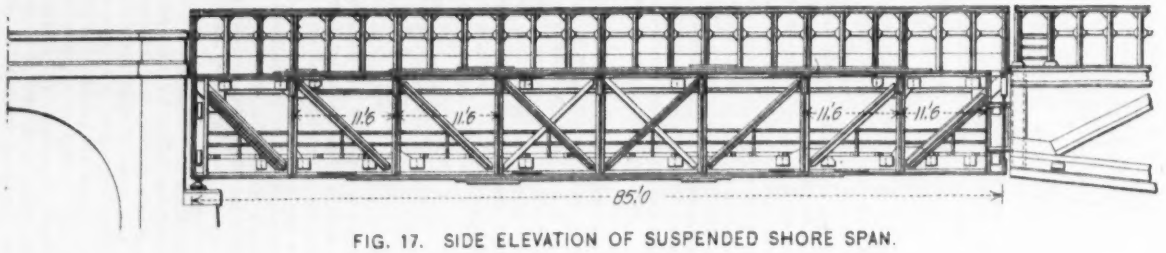


FIG. 17. SIDE ELEVATION OF SUSPENDED SHORE SPAN.

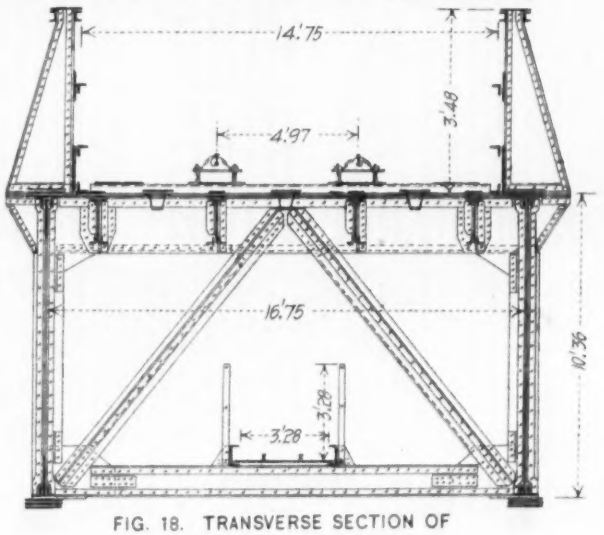


FIG. 18. TRANSVERSE SECTION OF SUSPENDED SHORE SPAN.

DETAILS OF THE 721 FT. STEEL ARCH SPAN OF THE VIAUR VIADUCT, FRANCE.

CHAS. HART, LITH., 39 VESEY ST., N. Y.

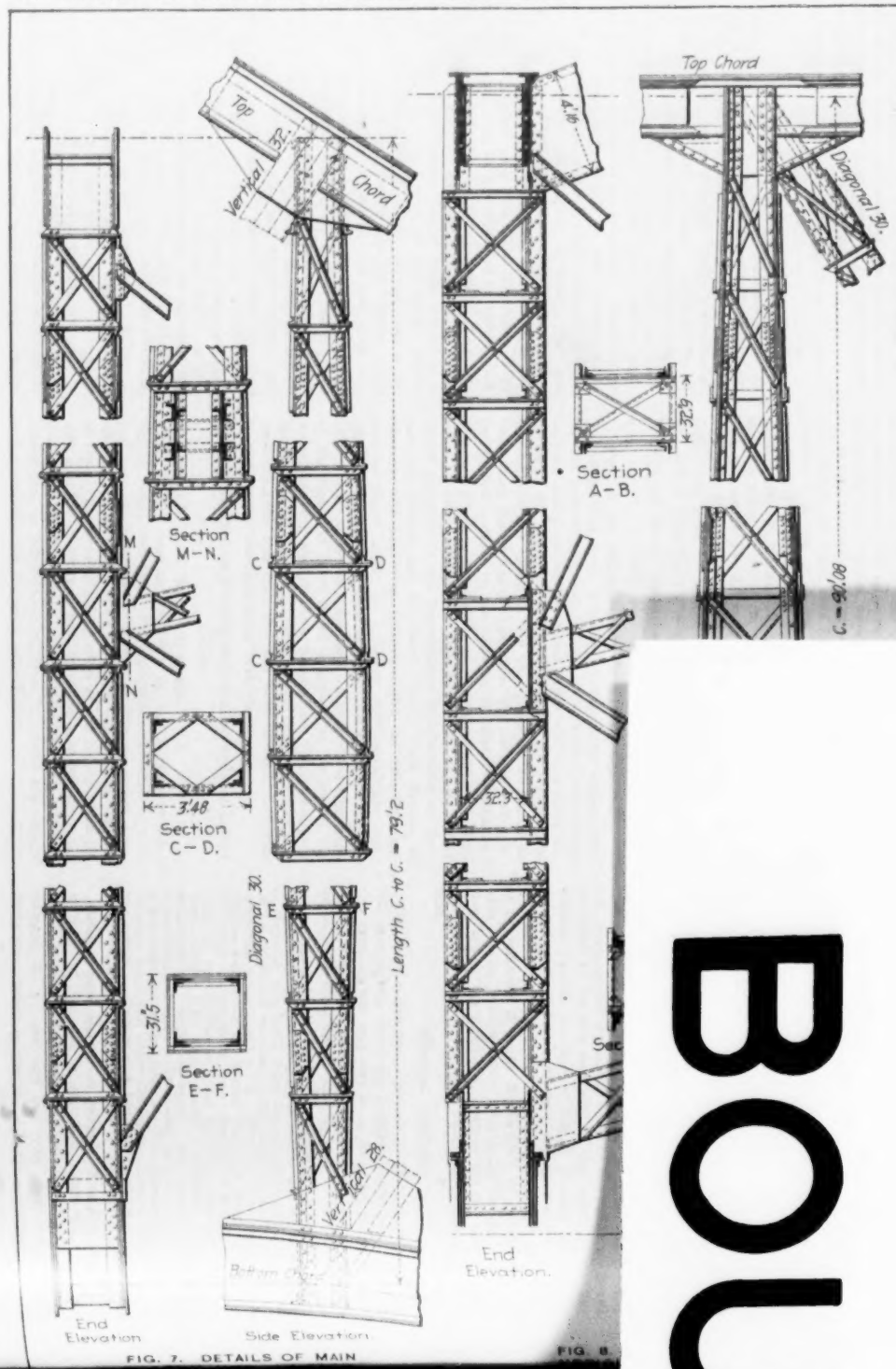


FIG. 7. DETAILS OF MAIN

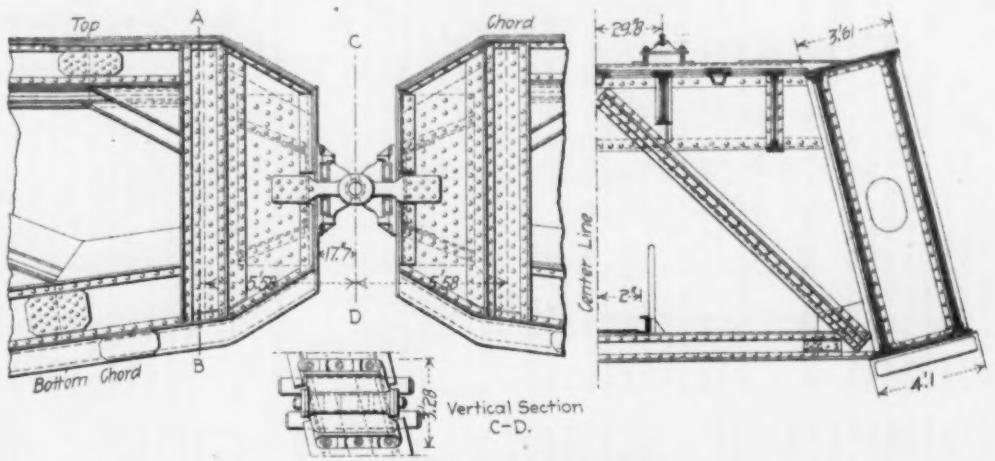
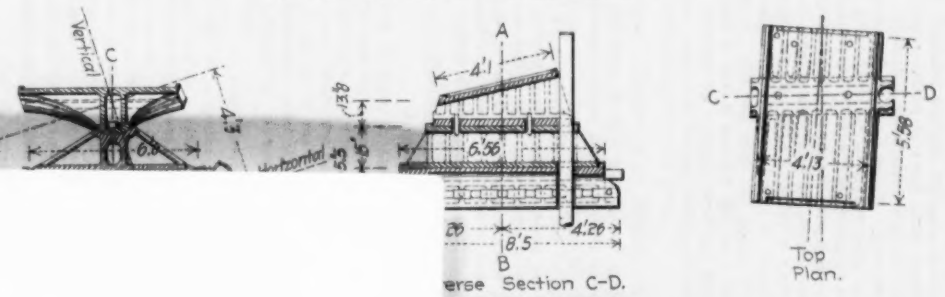
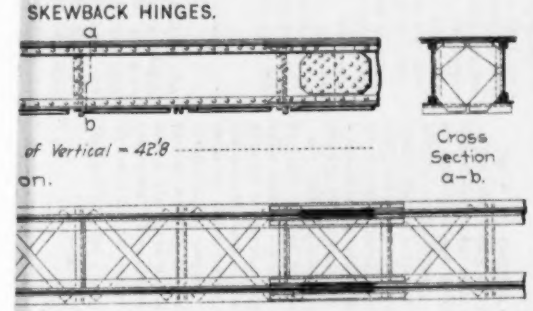


FIG. 16. DETAILS OF CENTER HINGE.



erse Section C-D.

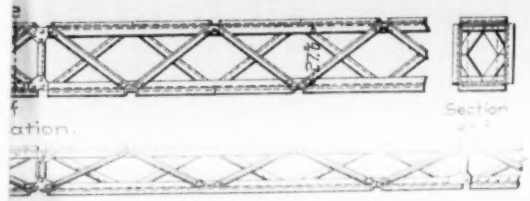
SKEWBACK HINGES.



of Vertical = 42'8

on.

OP CHORD CONSTRUCTION.



ation.

an.

OR BOTTOM CHORD LATERAL BRACING

TIGHT BOUND

GROUND
HTLY

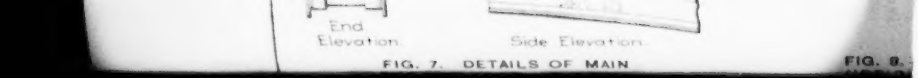
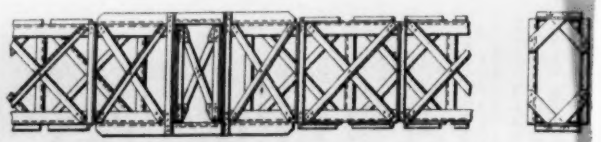
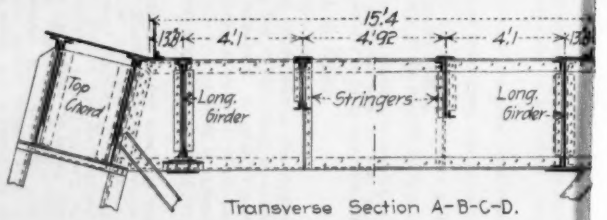


FIG. 7. DETAILS OF MAIN

FIG. 8.



Vertical Section M-N.



Transverse Section A-B-C-D.

Top Plan.

FIG. 11. BOX FLOOR GIRDER FOR MAIN AND CANTILEVER SPANS.

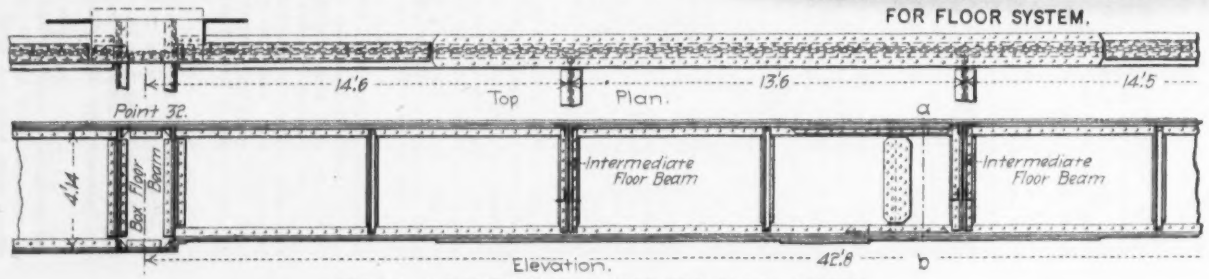


FIG. 12. LONGITUDINAL GIRDER FOR FLOOR SYSTEM.

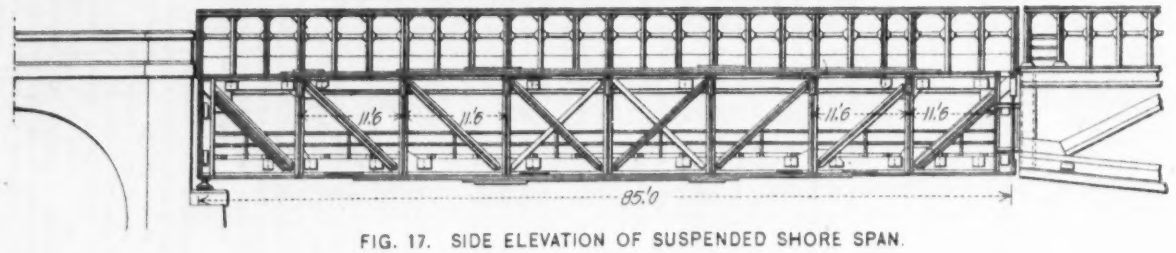
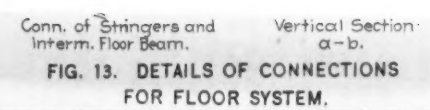


FIG. 17. SIDE ELEVATION OF SUSPENDED SHORE SPAN.

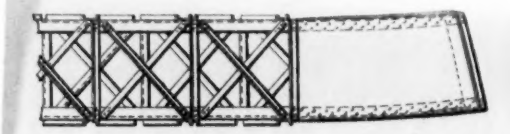


Conn. of Stringers and Interm. Floor Beam.

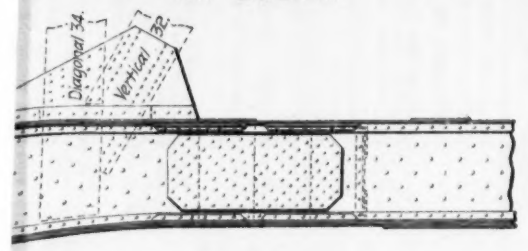
Vertical Section a-b.

FIG. 13. DETAILS OF CONNECTIONS FOR FLOOR SYSTEM.

OR BOTTOM CHORD LATERAL BRACING



Part Elevation.



Side Elevation.

Top Plan.

FIG. 6. DETAILS OF BOTTOM CHORD CONSTRUCTION.

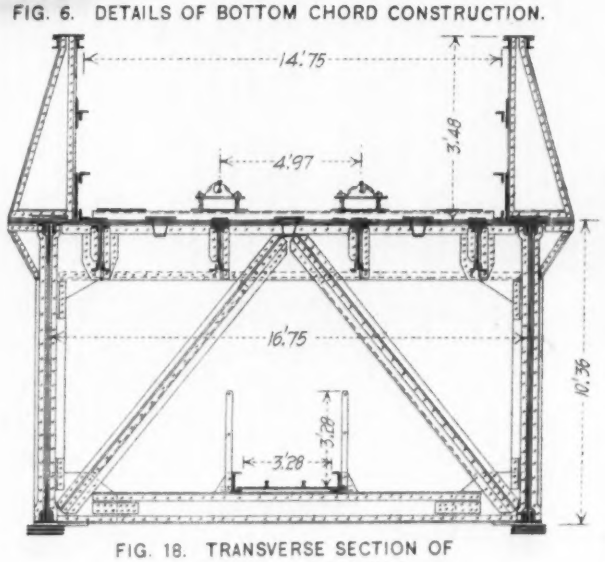


FIG. 18. TRANSVERSE SECTION OF SUSPENDED SHORE SPAN.

DETAILS OF THE 721 FT. STEEL ARCH SPAN OF THE VIAUR VIADUCT, FRANCE.

CHAS. HART, LITH., 36 VESEY ST., N. Y.